Genesis HIGH SPEED

User Manual

English

Data Acquisition System

GEN series

HBM

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Unless with reference to the IM2 in which case references are made to Perception 6.20 or higher.

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1 Safety Messages

1.1 FCC and general

The first WARNING note below is required by the FCC and relates only to the interference potential of this equipment. This message is a direct quotation.

WARNING

The equipment generates, uses, and can radiate radio frequency energy and if not installed and used in accordance with the instructions manual, may cause interference to radio communications. As temporarily permitted by regulation, it has not been tested for compliance with the limits for Class A computing devices pursuant to Subpart B or Part 15 of FCC Rules, which are designed to provide reasonable protection against such interference. Operation of this equipment in a residential area is likely to cause interference, in which case the user at his own expense will be required to take whatever measures may be required to correct the interference.

The design of this instrument has been verified to EN 61010 for Class 1 (grounded use).

This manual contains information and warnings that must be observed to keep the instrument in a safe condition. The instrument should not be switched on if it is damaged and it should not be used under wet conditions.

For the correct and safe use of this instrument it is essential that both operating and service personnel follow generally accepted safety procedures in addition to the safety precautions specified in this manual.

Whenever it is likely that safety protection has been impaired, the instrument must be made inoperative and secured against any unintended operation. Qualified maintenance or repair personnel should be informed. Safety protection is likely to be impaired if, for example, the instrument shows visible damage or fails to operate normally.

This instrument must not be used in life support roles.

1.2 Grounding

The instrument must be used with a protective ground connected via the conductor of the supply cable. This is connected to the instrument before the line and neutral connections when the supply connection is made. If the final connection to the supply is made elsewhere, ensure that the ground connection is made before line and neutral.

WARNING

Any interruption of the ground connection inside or outside is likely to make the instrument dangerous. Intentional interruption is prohibited.

For protection against electric shock, all external circuits or equipment shall have a safe insulation. Therefore it is not permitted to connect peripheral equipment to the system with a power supply without SELV (Separated Extra Low Voltage) or Class II qualification.

Signal connections to the instrument should be connected after the ground is made and disconnected before the ground connection is removed, i.e. the supply lead must be connected whenever signal leads are connected.

WARNING

It is recommended that signal grounds always be connected to a local ground. For safety, it is essential that a signal earth be connected whenever voltages greater than 40 V peak are connected. This is to prevent the instrument's case becoming live in the event of a safety ground interruption, which could occur if the supply connector is accidentally disconnected from the rear of the instrument.

It is the responsibility of the user to ensure the safety of any accessories, such as probes, used with the instrument.

CAUTION

Even low voltage inputs may contain high voltage fast transients (spikes), which could damage the input. For this reason it is not safe, for instance, to make direct connections to an AC line supply.

CAUTION

For input BNCs that are galvanically isolated from the chassis. Input conductors including the BNC shell may carry hazardous voltages. Only appropriate insulated BNC connectors should be used.

WARNING

All inputs are rated for IEC 61010 CAT I (Category 1) signals only. This instrument should not be used to measure high-energy signals of Categories II, III, and IV.

The covers protect the user from live parts and should only be removed by suitably qualified personnel for maintenance and repair purposes.

The instrument must not be operated with the covers removed.

There are no user serviceable parts inside.

1.3 Electro Static Discharge (ESD)

Electrostatic discharge (ESD) can cause damage to electronic devices if discharged into the device, so you should take steps to avoid such an occurrence.

CAUTION

HBM uses state-of-the-art electronic components in its equipment. These electronic components can be damaged by discharge of static electricity (ESD). ESD damage is quite easy to induce, often hard to detect, and always costly. Therefore we must emphasize on the importance of ESD preventions when handling a GEN series system, its connections or a plug-in card.

Description of ESD

Static electricity is an electrical charge caused by the buildup of excess electrons on the surface of a material. To most people, static electricity and ESD are nothing more than annoyances. For example, after walking over a carpet while scuffing your feet, building up electrons on your body, you may get a shock - the discharge event - when you touch a metal doorknob. This little shock discharges the built-up static electricity.

ESD-susceptible equipment

Even a small amount of ESD can harm circuitry, so when working with electronic devices, take measures to help protect your electronic devices, including your GEN series data acquisition system, from ESD harm. Although HBM has built protections against ESD into its products, ESD unfortunately exists and, unless neutralized, could build up to levels that could harm your equipment. Any electronic device that contains an external entry point for plugging in anything from cables to acquisition cards is susceptible to entry of ESD.

Precautions against ESD

Make sure to discharge any built-up static electricity from yourself and your electronic devices before touching an electronic device, before connecting one device to another, or replacing acquisition cards. You can do this in many ways, including the following:

- Ground yourself by touching a metal surface that is at earth ground. For example, if your computer has a metal case and is plugged into a standard three-prong grounded outlet, touching the case should discharge the ESD on your body.
- Increase the relative humidity of your environment.
- Install ESD-specific prevention items, such as grounding mats and wrist straps.

While you should always take appropriate precautions to discharge static electricity, if you are in an environment where you notice ESD events, you may want to take extra precautions to protect your electronic equipment against ESD.

The use of wrist straps
Use an ESD wrist strap whenever you open a chassis, particularly when you will be handling circuit cards and components. In order to work properly, the wrist strap must make good contact at both ends (with your skin at one end, and with the chassis at the other).

WARNING

The wrist strap is intended for static control only. It will not reduce or increase your risk of receiving an electric shock from electrical equipment. Follow the same precautions you would use without a wrist strap.

1.4 Environment

HBM instruments should be operated in a clean, dry environment in general with an ambient temperature of between 0 °C and +35 - 40 °C depending on the model. Please refer to the correct specifications section for more details.

The instrument is specified for use in a Pollution Category II environment, which is normally nonconductive with temporary light condensation, but it must not be operated while condensation is present. It should not be used in more hostile, dusty or wet conditions.

Note *Direct sunlight, radiators and other heat sources should be taken into account when assessing the ambient temperature.*

The instrument relies on forced air-cooling with fan and ventilation apertures. Adequate ventilation can usually be achieved by leaving a 75 mm (3" gap) around the instrument. Care should be taken to avoid restricting the airflow around the fan holes at the side of the instrument.

To clean the instrument, disconnect all power sources and wipe the surfaces lightly with a clean, soft cloth dampened with water.

1.5 Power and frequency requirements

The GEN series tower model uses up to 450 VA and operates from line voltages of 85 Vac to 264 Vac at 47-63 Hz to installation Overvoltage Category II, local level supplies distributed within a building. The GEN series rack model uses up to 1200 VA and operates from lines voltages of 100 Vac to 240 Vac. They can also be used with 400 Hz power inputs with slightly higher leakage current from line to ground. Under the extreme conditions of 85 V and 47 Hz, the instrument will still operate correctly even if there is a half cycle dropout in the line supply.

The power connection of the tower model is via a standard IEC, CEE 22 connector. Access to the AC supply fuse(s) can only be made if the AC supply connector is removed. A 6.3 A fuse must always be used.

The power connection of the rack model is via a IEC/EN 60320-1/C20 connector. This connector is part of a high current power entry module with built-in 2-pole rocker actuated circuit breaker.

To disconnect the instrument from the AC supply, unplug the IEC connector on the rear of the instrument. The instrument should be positioned to allow access to the AC connector. The front power switch on the instrument is not a disconnecting device. When the instrument is connected some power will be consumed.

CAUTION

Do not position this instrument so that it is difficult to remove the power input cable.

1.6 Electro-Magnetic Compatibility (EMC)

EMC stands for Electro-Magnetic Compatibility. The overall intention is that electronic equipment must be able to co-exist with other electronic equipment in its immediate vicinity and neither emits large amounts of electromagnetic energy. Thus there are two distinct requirements for electromagnetic compatibility: Emission and Immunity.

This instrument generates, accepts and can radiate radio frequency energy and, if not installed and used in accordance with the operator manual, may cause harmful interference to other equipment. However, there is no guarantee that interference will not occur in a particular installation.

Immunity test: All immunity tests are done with the failure criterion being a change of the instrument's control settings. Any of these tests may produce a spurious trigger. Measurements are not valid during and immediately after the immunity tests.

In demanding applications, if this instrument does cause minor harmful interference to other equipment, which can be determined by turning this instrument off and on, the user is encouraged to try to reduce the interference by one or more of the following measures:

- Re-orient or relocate the affected equipment.
- Increase the distance between the instrument and the affected equipment.
- Re-orient or relocate interface cables.
- Connect the instrument to an outlet on a different supply circuit to the affected equipment.

Supply cables, interface cables and probes should be kept as short as practical, preferably a maximum of 1 m. Interface cables should be screened and interface cables longer than 3 m are not acceptable in terms of interference port immunity.

1.7 Fuse requirements and protection

The GEN series tower model is equipped with a replaceable fuse. The fuse arrangement stated here must be followed and, additionally, in the UK a fuse should be fitted in the line supply plug.

The fuse must be slow blow (T) & High Breaking Capacity (H). Fuse rating of 6.3 A or 16 A, depending on mainframe. Please refer to Specifications for more information.

WARNING

Any interruption of the protective conductor inside or outside the apparatus or disconnection of the protective earth terminal is likely to make the apparatus dangerous. Intentional interruption is prohibited.

When the apparatus is connected to its supply, terminals may be live, and the opening of covers for removal of parts is likely to expose live parts.

Whenever it is likely that the protection has been impaired, the apparatus shall be made inoperative and be secured against any unintended operation.

The protection is likely to be impaired if, for example, the apparatus shows visible damage or has been subjected to severe transport stresses.

WARNING

ELECTRICAL SHOCK HAZARD! Do not remove covers. Refer servicing to qualified individuals.

Proper use of this device depends on careful reading of all instructions and labels.

If the instrument is used in a manner not specified by HBM, the protection provided by the instrument can be impaired.

WARNING

This instrument must not be operated in explosive atmospheres.

WARNING

This instrument and related accessories are not designed for biomedical experimentation on humans and should not be directly connected to human subjects or used for patient monitoring.

1.8 Overvoltage/current protection

All signal inputs are protected against overloads of ± 250 Vpk continuously and 1000 V transient. Exceeding these limits, particularly when connected to potentially high-current sources, can cause severe damage that is not covered by the manufacturer's warranty.

WARNING

Never connect input(s) to hazardous circuits; measurement voltages must be less than 50 Vpk, transient-free.

1.9 Instrument symbols

On the system a variety of symbols can be found. Below is a list of symbols and their meaning.

This symbol is used to denote the measurement ground connection. This point is not a safety ground.

This symbol is used to denote a safety ground connection.

Where caution is required, this symbol refers to the User's Guide for further information.

This symbol warns that high voltages are present close to this symbol.

This symbol shows that the switch is a standby switch. When it is pressed, the instrument state toggles between operating and stand by mode. In standby mode some power will be consumed and the instrument is NOT disconnected from the AC supply.

1.10 Manual handling of loads

The Manual Handling of Loads Directive 90/269/ EEC from the European Community lays down the minimum health and safety requirements for the manual handling of loads where there is a risk particularly of back injury.

CAUTION

The weight of the instrument may exceed 25 kg when fully loaded. Please take appropriate actions before lifting the instrument.

Before lifting or carrying a heavy object, ask yourself the following questions:

- Can you lift this load safely, or is it a two-person lift?
- How far will you have to carry the load?
- Is the path clear of clutter, cords, slippery areas, overhangs, stairs, curbs or uneven surfaces?
- Will you encounter closed doors that need to be opened?
- Once the load is lifted, will it block your view?
- Can the load be broken down into smaller parts?
- Should you wear gloves to get a better grip and protect your hands?

Contact the “Occupational Health and Safety” organization, or equivalent, in your country for more information.

The GEN series tower model (GEN7t) weights approximately 20-25 kg:

The GEN series rack model (GEN16t) model weights approximately 25-30 kg:

DO NOT LIFT ALONE

1.11 International safety warnings

Dansk

SIKKERHEDSADVARSEL
Dette instrument skal anvendes med en beskyttelsesjordforbindelse via netkablets jordledning til jordforbindelsen i instrumentets apparatkontakt eller - hvis instrumentet er forsynet dermed - via sikkerhedsjordklemmen. Enhver afbrydelse af sikkerhedsjordforbindelsen vil formentlig gøre instrumentet berøringsfarligt. Bevidst afbrydelse er forbudt. Hvis et indgangssignal overstiger 40 V spidsværdi, skal en ekstra signal jord forbindes.

Dækslerne må ikke fjernes.

Hvis netsikringen springer som følge af en fejl, er det muligt at instrumentets AC netafbryder er blevet beskadiget, hvorfor den bør efterses af en kvalificeret tekniker.

Afbryd instrumentet fra lysnettet ved at fjerne IECstikket fra bagpanelet. Dette instruments AC netafbryder er kun beregnet til funktionelle formål. Den er hverken beregnet til eller egnet til afbrydelse af lysnettet.

Nederlands

VEILIGHEIDSWAARSCHUWING
Dit instrument mag uitsluitend worden gebruikt als een beschermende massa (aarde) is aangesloten via de beschermende massageleider van de voedingskabel, of - indien het instrument daarvan is voorzien - via de veiligheids-massa-aansluiting. Als de beschermende massa, binnen of buiten het instrument, wordt onderbroken, dan kan dat hierdoor uitermate gevaarlijk worden. Het opzettelijk onderbreken van de massa, is verboden. Indien er een signaal wordt aangeboden van meer dan 40 V (top-top) dan dient eveneens de signaal aarde aangesloten te zijn.

De deksels nooit verwijderen.

Als de zekering doorbrandt als gevolg van een storing of een defect, dan is het mogelijk dat de wisselstroom-voedingsschakelaar van het instrument beschadigd is. Die schakelaar moet worden gecontroleerd door een deskundig technicus.

Als de IEC-aansluiting op het achterpaneel uit het stopcontact wordt verwijderd, zal het instrument niet langer zijn aangesloten op de wisselstroomvoeding. De wisselstroom-voedingsschakelaar op dit instrument is uitsluitend bestemd voor functionele doeleinden. Die schakelaar mag nooit worden gebruikt om het instrument aan of af te zetten.

Suomi

TURVAOHJEITA
Tätä laitetta käytettäessä sen tulee olla suojamaadoitettu joko verkkojohdon suojajohtimen tai erillisen suojamaadoitusliitännän kautta, mikäli laitteeseen on sellainen asennettu. Suojamaadoituksen katkaiseminen laitteen sisä-tai ulkopuolelta tekevät siitä vaarallisen. Tahallinen katkaisu on kiellettyä. Lisäksi, jos jokin tulosignaaleista ylittää 40 V peak, on signaalimaa kytkettävä.

Älä poista suojakansia.

Mikäli laitteen verkkosulake palaa vian seurauksena, on mahdollista, että laitteen verkkokytkin on vaurioitunut ja se tulee tällöin tarkastuttaa ammattihenkilöllä.

Erottaaksesi tämän laitteen käyttöjännitteestä irrota takapaneelissa oleva IEC-liitin. Tämän laitteen verkkokytkimellä on ainoastaan toiminnallinen tarkoitus. Sitä ei ole tarkoitettu, eikä se sovellu laitteen erottamiseen käyttöjännitteestä.

Français

ATTENTION - DANGER!
Cet appareil doit impérativement être mis à la masse par le conducteur de terre du câble d'alimentation ou, si l'instrument en comporte une, par la borne de terre. Il peut être dangereux en cas de coupure du circuit de terre, que ce soit à l'intérieur ou à l'extérieur de l'instrument. Il est formellement interdit de couper intentionnellement le circuit de terre. De plus, une masse signal doit être connectée si l'un quelconque des signaux d'entrée dépasse 40 V crête.

Ne pas déposer les panneaux de protection.

Le fait que le fusible d'alimentation saute par suite d'une anomalie risque de détériorer l'alimentation secteur de l'instrument; dans ce cas, le faire contrôler par un technicien qualifié.

Pour couper l'alimentation secteur de cet instrument, débrancher le cordon secteur monté à l'arrière. L'interrupteur d'alimentation est purement secteur fonctionnel. Il ne s'agit pas d'un dispositif de coupure du courant, et n'est pas conçu pour cette fonction.

Deutsch

WARNHINWEIS!
Dieses Gerät muß mit einer Schutzerde betrieben werden, die über den Schutzleiter des Speisekabels oder über die Erdungsklemme des Gerätes (falls vorhanden) anzuschließen ist. Bei einer Unterbrechung der Schutzerde außerhalb oder innerhalb des Gerätes kann eine Gefahr am Gerät entstehen! Eine beabsichtigte Unterbrechung ist nicht zulässig. Achtung! Bei Signalspannungen über 40 V muß die Signalmasse angeschlossen sein.

Die Schutzabdeckung nicht entfernen.

Wenn die Sicherung der Versorgung infolge eines Defektes durchbrennt, besteht die Möglichkeit einer Beschädigung des Wechselstromversorgungs-Schalters des Gerätes. Der Schalter muss dann von einem qualifizierten Elektriker geprüft werden.

Zum Trennen des Gerätes von der Wechselstromversorgung den IEC-Stecker von der Rückwand abziehen. Der Wechselstromversorgungs-Schalter dient bei diesem Gerät nur für Funktionszwecke. Er ist nicht als Trennvorrichtung bestimmt bzw. geeignet!

Italiano

AVVISO DI SICUREZZA
Questo strumento deve esser utilizzato con un collegamento protettivo di messa a terra tramite il filo di messa a terra del cavo di alimentazione o tramite il terminale di messa a terra in sicurezza, nel caso in cui lo strumento ne sia dotato. Qualsiasi interruzione della massa a terra protettiva, sia all'interno che all'esterno dello strumento, lo renderà pericoloso. E'vietata qualsiasi interruzione causata intenzionalmente. Inoltre, la connessione di terra deve essere collegata se ad uno qualsiasi degli ingressi viene applicato un segnale superiore a 40 V di picco.

Non aprire lo strumento.

Nel caso in cui il fusibile dell'alimentazione dovesse scattare a causa di un guasto, è possibile che l'interruttore dell'alimentazione a corrente alternata dello strumento possa essere danneggiato e dovrà pertanto essere controllato da un tecnico specializzato e qualificato.

Per disinnestare questo strumento dall'alimentazione a corrente alternata, levare il connettore IEC che si trova sul pannello posteriore. L'interruttore dell'alimentazione a corrente alternata di questo strumento viene fornito esclusivamente per scopi operativi e non viene inteso, né è adatto, per essere utilizzato come dispositivo di disinnesto.

Norsk

ADVARSEL!
Dette instrumentet må bare anvendes så lenge det er jordet via den beskyttende jordlederen i strømkabelen, eller via jordingsklemmen, hvis instrumentet har en. Eventuelle forstyrrelser i den beskyttende jordingen, inne i eller utenfor instrumentet, vil sannsynligvis gjøre instrumentet farlig. Forsettlig forstyrrelse er forbudt. I tillegg, signal jord må tilkobles dersom inngangs signalet overstiger 40 V spissverdi.

Ikke fjern dekslene

Hvis sikringen springer på grunn av feil som oppstår, er det mulig at instrumentets vekselstrømbryter kan bli skadet - den må derfor kontrolleres av en kvalifisert ingeniør.

Skal instrumentet koples fra vekselstrømtilførselen, kopler man ut IECkoplingen bak på panelet. Vekselstrømbryteren på dette instrumente tjener kun en funksjonell hensikt. Den er ikke egnet, og må ikke brukes, som skillebryter.

Português

AVISO DE SEGURANÇA
Este aparelho deve ser operado com uma ligação terra ligado por um conductor trifásico do cabo principal ou, se o instrumento já tiver um, via um terminal de segurança. Qualquer interrupção do trifásico, dentro ou fora do aparelho, pode tornar o aparelho perigoso. É proibida a interrupção intencional. Nota: O terminal de terra deve ser ligado se o sinal de entrada a medir for superior a 40 V de pico.

Não retire o invólucro/capas.

Se o fusîvel suplementar queimar por causa de erro, é possivel que o interruptor da fonte AC do aparelho esteja com defeito e deveria ser checado por pessoa autorizada.

Para desconectar este aparelho da fonte AC, retire o conector IEC do painel trazeiro. Neste aparelho, o interruptor da fonte AC existe sómente por razões funcionais. Não deve ser usado e nem é apropriado como dispositivo de desconexão.

Español

ADVERTENCIA SOBRE SEGURIDAD
Este instrumento debe utilizarse conectado a tierra a través del conductor de puesta a tierra del cable de alimentación o de la borna de seguridad, si dicho instrumento estuviera equipado con ella. Cualquier interrupción de esta puesta a tierra, dentro o fuera del instrumento, hará que el manejo del mismo resulte peligroso. Queda terminantemente prohibido dejar en circuito abierto dicha puesta a tierra. Además, debe conectarse una señal de tierra si cualquier señal de entrade sobrepasa los 40 V de pico.

No quite las tapas.

Si se fundiera el fusible de alimentación como consecuencia de una avería, cabe la posibilidad de que el interruptor de encendido del equipo esté dañado y sea necesario comprobarlo por personal técnico especializado y autorizado al efecto.

Para desconectar este instrumento de la red, desenchufe el conector IEC del panel trasero. El interruptor de entrada de CA (encendido) se incluye solo para fines funcionales. No está pensado para utilizarse como medio de desconexión, ni tampoco es adecuado para ello.

Svenska

SÄKERHETSVARNING
Detta instrument måste drivas med en skyddande jordledning ansluten via den skyddande jordledaren på matarkabeln eller, om instrumentet har sådan monterad, via det jordade uttaget. Om jordanslutningen störs, inuti eller utanför instrumentet, är det troligt att instrumentet kommer att utgöra en fara. Avsiktlig störning är förbjuden. Dessutom måste en signaljord anslutas om någon av ingångssignalerna överstiger 40 V topp.

Tag ej bort skydden.

Om matarsäkringen smälter på grund av ett fel är det möjligt att strömställaren för växelströmsmatning på instrumentet skadas och den bör då inspekteras av en ingenjör med lämpliga kvalifikationer.

För att koppla bort instrumentet från växelströmstillförseln, tag ut IEC-anslutningen på bakpanelen. Strömställaren för växelströmstillförsel på detta instrument är enbart till för funktionerliga ändamål. Den är inte avsedd som, eller lämplig som, en bortkopplingsanordning.

English

SAFETY WARNING
This instrument must be operated with a protective ground (earth) connected via the protective ground conductor of the supply cable or, if the instrument is fitted with one, via the safety ground terminal. Any interruption of the protective ground, inside or outside the instrument, is likely to make the instrument dangerous. Intentional interruption is prohibited. In addition, a signal ground must be connected if any input signal exceeds 40 V peak.

Do not remove the covers.

If the supply fuse blows as the result of a fault, it is possible that the instrument's AC supply switch will be damaged and should be checked by a suitably qualified engineer.

To disconnect this instrument from the AC supply, unplug the IEC connector on the rear panel. The AC supply switch on this instrument is provided for functional purposes only. It is not intended, or suitable, as a disconnecting device.

日本語

安全上の警告
本機器の操作は、電源ケーブルの保護接地線で接地（アース）を施した上で行ってください。また、安全接地用端子が存在する場合は、これを経由して本機器を接地してください。機器の内部または外部にある保護接地線が遮断されると、機器が危険な状態に陥る可能性があります。故意に保護接地線を遮断することを禁止します。また、入力信号がピーク時に 40V を超える場合は、信号接地線を接続してください。

カバーは取り外さないでください。

電源ヒューズが故障により飛んだ場合、機器の AC 電 源スイッチが損傷するおそれがあるため、然るべき認 定を受けた適任者による点検を受けてください。

本機器を AC 電源から遮断するには、背面パネルにあ る IEC コネクターを抜きます。 本機器の AC 電源ス イッチは、機能上の目的のためだけに提供していま す。 したがって、機器の主電源遮断用として意図さ れていないか、適応していません。

中文

安全警告
该仪器必须通过电源电缆的导线连接到保护接地（接地），如果该仪器已配备了安全接地端子，则通过该端子接地。 断开仪器内外的任何保护接地可使仪器成为危险设备。 严禁有意断开。 另外，如有任何输入信号超过 40 V 的峰值，还必须连接信号接地。

不要取下保护盖。

如果电源保险丝因故障而熔断，则有可能损坏仪器的 交流电源开关并应由具备资格的工程师检查。

拔下仪器后面板上的 IEC 接头即可断开交流电源。 仪器上的交流电源开关仅用于功能性目的。 而不是 用于或适用于断开设备。

1.12 Declaration of conformity

For information about the EC Declaration refer to www.hbm.com/highspeed.

2 About this Manual

2.1 Symbols used in this manual

The following symbols are used throughout this manual to indicate warnings and cautions.

WARNING

Indicates a potentially hazardous situation which, if not avoided, could result in minor or moderate injury; or alerts against unsafe practices; or alerts against actions which could damage the product, or result in a loss of data.

WARNING

Indicates an electrical shock hazard which, if not avoided, could result in death or serious injury.

CAUTION

Indicates a potentially hazardous situation which, if not avoided, could result in minor or moderate injury, or alerts against unsafe practices; or alerts against actions which could damage the product, or result in loss of data.

CAUTION

The ESD susceptibility symbol indicates that handling or use of an item may result in damage from ESD if proper precautions are not taken.

HINT/TIP

The info icon indicates sections which give additional information about the product. This information is not essential for correct operation of the instrument, but provides knowledge to make better use of the instrument.

2.2 Manual conventions

For clarity and convenience, these conventions are used throughout this manual:

- **Menu names** from the local display appear in bold, blue lettering.
- **Settings** within a menu appear in bold, red lettering.
- **Front panel controls** and **control names** appear in bold, black lettering.

3 Introduction

3.1 Introducing the GEN series

Welcome.You have made the right choice: your GEN series Data Acquisition System is one of the most sophisticated and powerful systems in the marketplace and demonstrates the quality HBM has to offer. The GEN series system is “future-proof”, modular and easily extendable. Using the basic data acquisition building blocks - Signal Conditioning, Acquisition, Storage, Analysis and Control you can determine what capabilities are required and maintain a system that is right for you. Some of the main features include:

- Combines a transient recorder and data acquisition system
- Combines time domain and frequency domain performance
- Provides sample rates ranging from 200 kS/s to 100 MS/s
- Transient RAM typically provides 8 to 64 MS per channel and goes up to 200 MS in parallel (equals 800 MS transient storage on a single channel)
- Isolated and non-isolated channels
- Unlimited recording size and duration
- High fidelity signal conditioning
- View and control anywhere on your network

Setup, real-time monitoring and control can be done from any PC using the Perception software, including wired, wireless and fiber-optic networks. HBM's exclusive StatStream® processing minimizes network traffic to assure quick updates and instant responsiveness even with thousands of channels enabled.

The GEN series Data Acquisition System consists of:

- GEN series mainframe
- Input modules with on-board signal conditioning
- Perception software
- An optional interface

and requires for the Perception control software:

- PC running Microsoft® Windows XP, Vista, 7 or later

The configuration of your GEN series depends on the modules you selected. A GEN7t tower mainframe holds up to seven input modules, a GEN16t rack mainframe up to 16.

HINT/TIP

Perception software automatically detects all available GEN series systems and can report their configuration.
References made in this manual to Perception are based on Perception version 6.14. As from version 6.02 (Perception and GEN series firmware) the Diagnose menu item on the front panel display control has been added.

3.2 Hardware

There are two different GEN series mainframes available:

- The 7-slot „tower“ mainframe is best for smaller channel count applications and easy to be transported.
- The 16-slot „rack“ mainframe offers higher channel count, and can be mounted in a rack or used stand alone.

All technical specifications except mechanics, power consumption and number of module slots are identical for both versions.

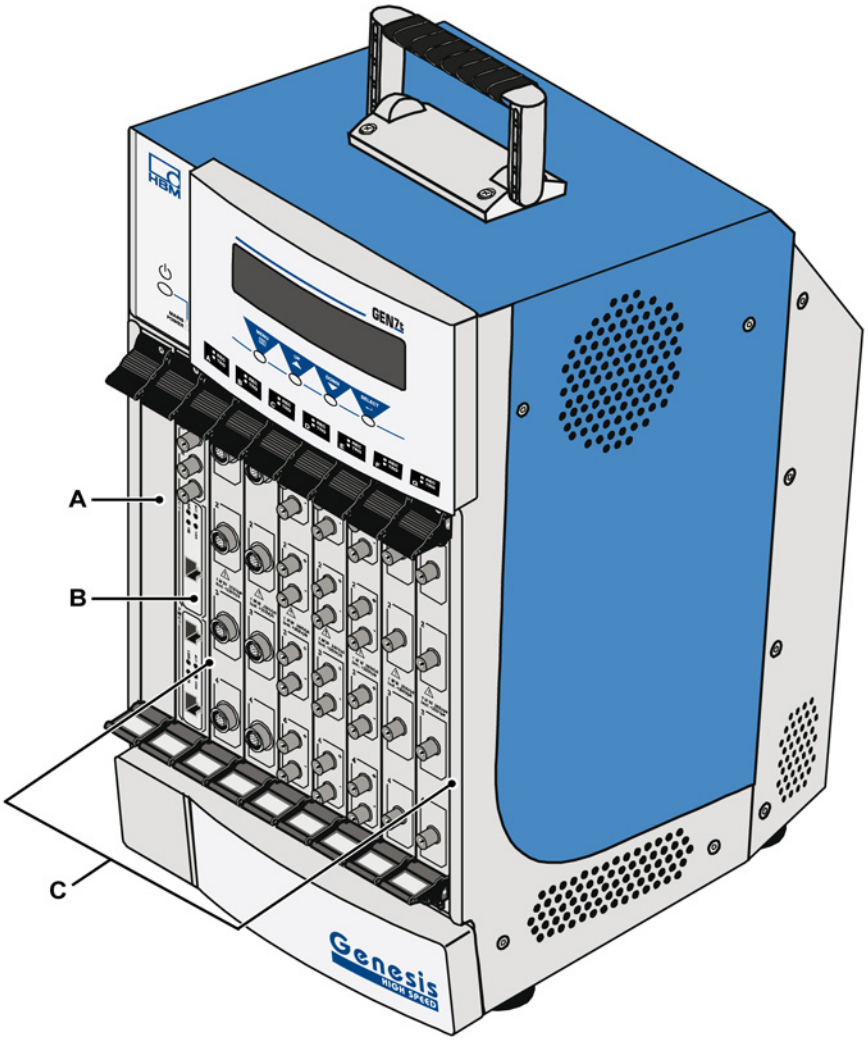


Figure 3.1: GEN series tower model (GEN7t)

A Empty Slot

B Controller and interface module

C Acquisition and Signal Conditioning Modules

3.2.1 Controller/interface module

The Controller/interface module runs a high-end CPU with an embedded real-time operating system. It can store to an optional local SCSI drive, or stream to a PC over Gigabit Ethernet. Communication as well as data transfer is through the Ethernet interface. The Module can house one option like SCSI or IRIG interface. For more information see “GEN series Options” on page 207.

The Controller/interface module IM1 and IM2 run on a high-end CPU with an embedded realtime operating system. The IM1 can store data on an optional local SCSI drive or stream to a PC over Gigabit Ethernet, the IM2 can store to an on board SSD and also stream across via the on-board Ethernet connection.

Communication as well as data transfer is through the available through a copper or fiber Ethernet interface.

The IM1 and IM2 Module can house one option like SCSI or IRIG for more information see “GEN series Options” on page 207.

3.2.2 Input modules

The GEN series tower mainframe can accept up to seven input modules. The 19” version can accommodate 16 cards. Each input module includes one or more digitizers, a powerful DSP for filtering and intelligent triggering, and a CPU running a real-time operating system for acquisition management. For the analog input section the GEN series input modules use signal conditioners that are daughter cards mounted integrally with the input module in the same slot. For more information on the various modules see “Input Modules” .

3.2.3 Master/slave module

For fully synchronous operation between multiple mainframes the master/slave module is used. The master/slave module synchronizes clocks, triggering, pause/stop and start signals between all connected mainframes. Connections are made using fiber-optic cables.

This option allows for a multi-mainframe configuration to work as a single unit. Within a combination of mainframes, one mainframe is used as a master that can drive up to eight slaves.

3.3 Acquisition

The GEN series is a multi-channel modular Data Acquisition System. It provides real-time data for waveform and meter displays. At a streaming rate determined by your PC and your network, it allows unlimited recording duration and file size. Statistics are performed in real-time. Its extreme-performance signal conditioning includes both Bessel and Butterworth anti-alias filters to provide excellent response.

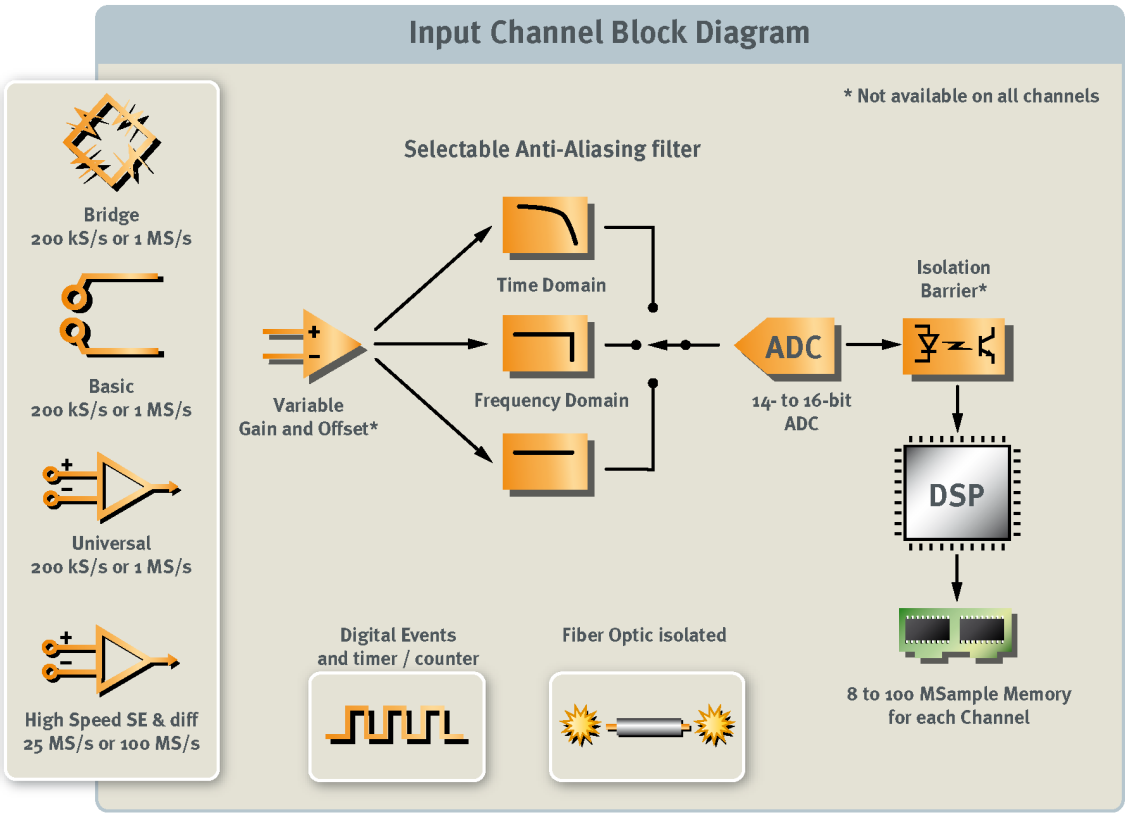


Figure 3.2: Input channel block diagram

It also functions as a transient recorder with a hardware trigger on all channels with hysteresis, delay and logic features. Transient memory is huge and can capture minutes of data at 1 MS/s on all channels. Segmented sweeps are displayed with no dead time and the recorder has a wide analog bandwidth.

3.3.1 StatStream®

Most PC-based DAQ systems can easily acquire megabytes of data. But even the most powerful PC is poorly equipped to display and process files of megabytes or gigabytes. In fact, most DAQ systems fail to display over 99% of your live data! The exclusive StatStream® technology accelerates all aspects of your measurement task with dedicated hardware and firmware.

While recording, StatStream® pre-processes a display summary at the full resolution of your PC monitor. Even a single transient point on any channel is accurately displayed.

In addition, StatStream® continuously calculates parameter values on blocks of data. You know the vital statistics at every moment, including warnings if any channel goes off scale. The Perception software offers a variety of meters to display these on-line parameters.

When reviewing your stored files, the embedded StatStream® data enables an accurate, detailed overview of any size file in seconds. Unlike competitive systems, your PC has no need to inspect gigabytes of information just to display the last kilobyte. As you zoom in, more detail is displayed while always maintaining the highest visible resolution.

3.4 Signal conditioning

The GEN series system supports common analog sensors with the highest performance signal conditioning available. All inputs are sampled simultaneously for exact time correlation, and the front ends deliver a typical maximum static error of 0.1%.

Typical inputs and sensors supported are:

- Voltage (single-ended and differential)
- Current
- Strain gages in any configuration
- IEPE (Integrated Electronics Piezo Electric, for example ICP®, CCLD, Isotron®, Deltatron®, Piezotron® and others)
- Resistive sensors (e.g. displacement, temperature)
- Binary and frequency (counter/timer)
- And more

Plug-and-play hardware discovery with scalability lets you configure any number of channels. Perception software can group and outline similar amplifiers for one-click settings. Extensive diagnostics give you the confidence of correctly wired and working sensors before running your test.

3.5 Data storage

In addition to mega samples of on-board RAM, you can record directly to your PC hard drive, removable disk, or network server over the Gigabit Ethernet. The GEN series system always stores to on-board high-speed RAM. Recorded data is then automatically stored to your PC at the maximum speed of your network and hard disk. At rates up to megabytes per second (dependent upon your PC), storage to the PC is continuous and unlimited duration recordings can be made.

The GEN series control module can be factory-equipped with an optional SCSI controller. The SCSI option provides expansion and flexibility, allowing GEN series users to add a wide range of external hard drives for local storage of recordings. For details on the SCSI controller see “GEN series Options” on page 207.

Recorded files are standard Windows files with extension pNRF (Perception Native Recording File).

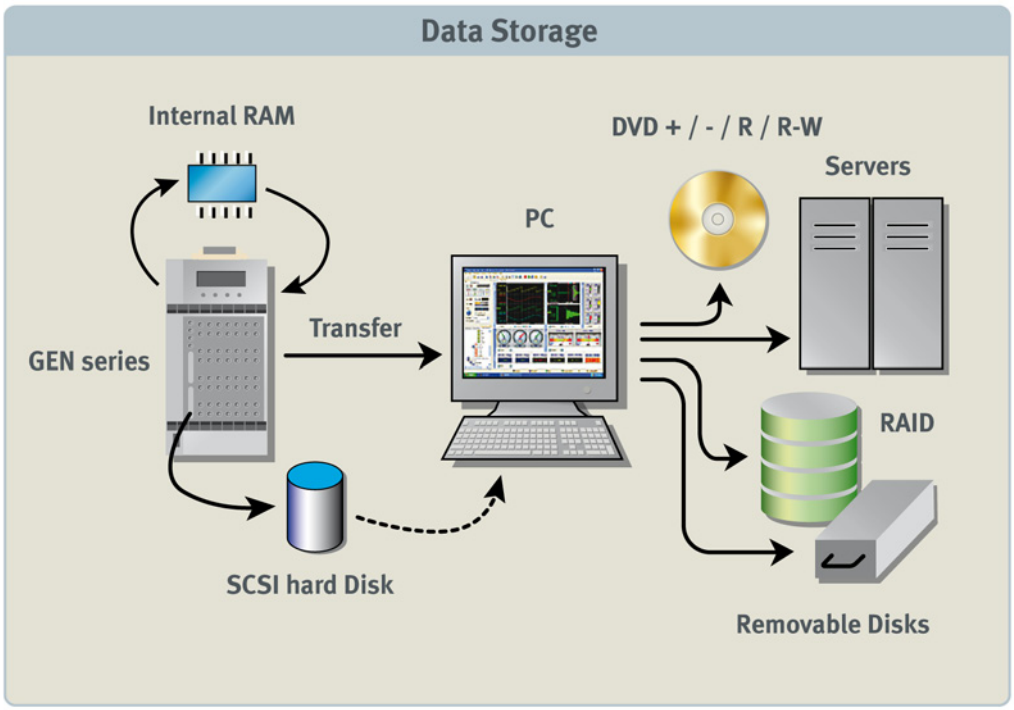


Figure 3.3: Data storage options

4 Setup your GEN series

4.1 Connecting power

The power outlet and the chassis ground lug are located on the bottom rear of the GEN series unit.

- The GEN7t model runs on 85-264 Vac from 47-63 Hz with 450 VA maximum.
- The GEN16t model runs on 100-240 Vac from 47-63 Hz with 1200 VA maximum.

Both models also operate with 400 Hz input power with slightly higher leakage current.

WARNING

ELECTRICAL SHOCK HAZARD!
Connect a Chassis Ground wire to prevent electric shock or damage to the GEN series.

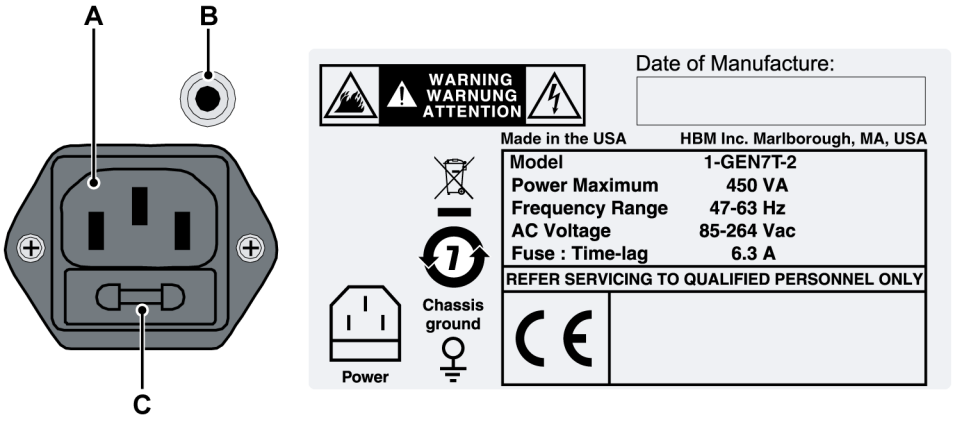


Figure 4.1: Connecting power (Tower model)

A Power

B Chassis Ground

C Fuses

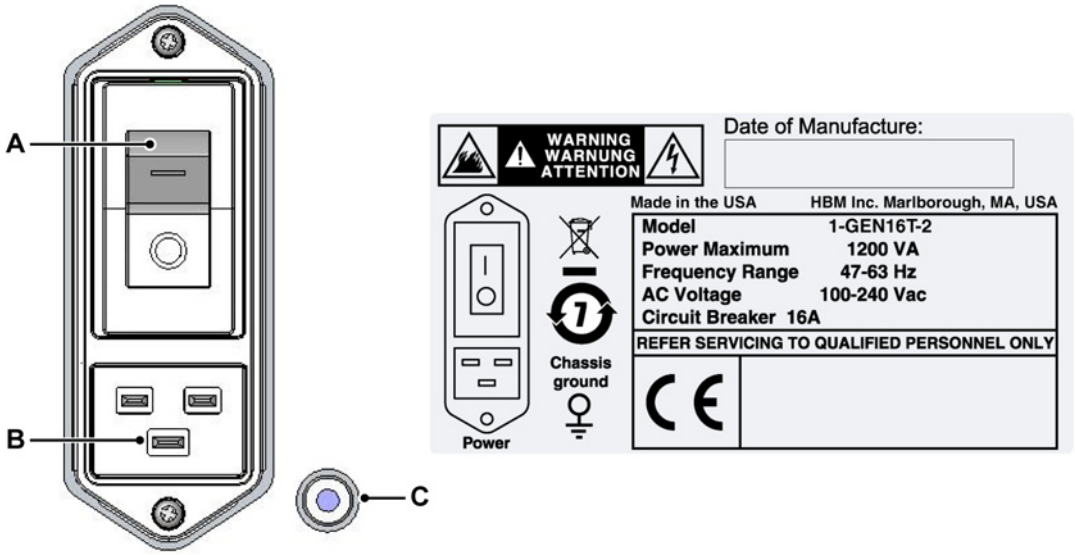


Figure 4.2: Connecting power (Rack model)

A Switch

B Power

C Chassis ground

4.1.1 Fuse replacement

The GEN series rack model is equipped with a 2-pole, rocker actuated circuit breaker type TA 45 (16 A) and has no additional fuses.

For the tower model defective fuses must be replaced with an identical 6.3 A slow blow type only.

To replace the fuse:

1. Power the system down and remove the line cord.
2. Use a small screwdriver to pry out the fuse holder.
3. Remove the defective fuse and replace with an identical 6.3 A slow blow type only.

4.2 Connecting to the network

The GEN series uses standard TCP/IP protocol over Ethernet to communicate with your PC. The Interface module provides access to the Ethernet network. Unshielded Twisted Pair (UTP) cable of Category 5E (Cat5e) or greater may be used up to 30 meters in length.

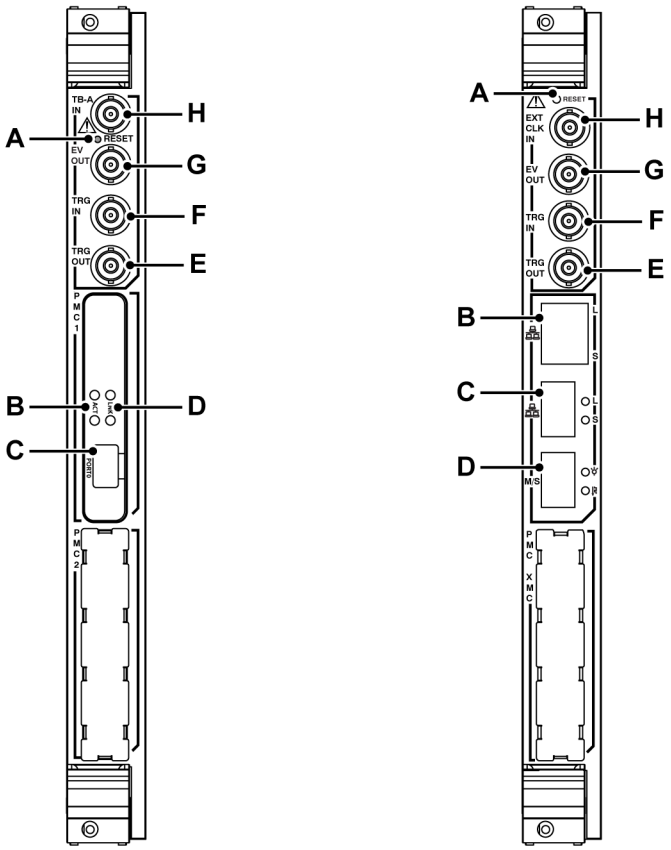


Figure 4.3: Interface modules (IM1-left) (IM2-right)

	IM1		IM2
A	Recessed CPU Reset Switch	**A**	Recessed CPU Reset Switch
B	Activity detected	**B**	RJ-45 Connector/Ethernet Port
C	RJ-45 Connector/Ethernet Port	**C**	SPF ethernet connector/SFP Port
D	Link detected	**D**	Synchronized recording
E	External Trigger Out	**E**	External Trigger Out
F	External Trigger In	**F**	External Trigger In
G	External Event Out	**G**	External Event Out
H	External Timebase In	**H**	External Timebase In

The module is equipped with an interface with 100/1000 Base-T Gigabit support. You must connect to the RJ-45 connector.

You can connect your GEN series in either of two ways:

- Directly to your PC, or
- To your company network

The GEN series is an extremely high-performance acquisition system that is capable of transferring Megabytes of data at high speed to your PC. For the best performance and fastest throughput, HBM strongly recommends the GEN series be connected directly to an Intel© Core 2 Duo based PC (or equivalent) with the CPU operating at a clock frequency of 2 GHz or greater and a 1 Gigabit Ethernet adapter.

If your PC also connects to your company network, a second hardware Ethernet adapter in your PC is recommended for this purpose. A second adapter preserves your Gigabit connection for the fastest possible data transfer, while preventing GEN series network traffic from potentially interfering with the company network performance.

4.2.1 Connecting the GEN series directly to your PC

You can connect the GEN series directly to your PC. In addition you can also at the same time connect your PC to a corporate network. For this you will need a PC with two Ethernet NICs (Network Interface Cards.) The one for the GEN series must be 1 Gbit for the best performance. You will require a Cat5e Ethernet cable from your PC to the GEN series.

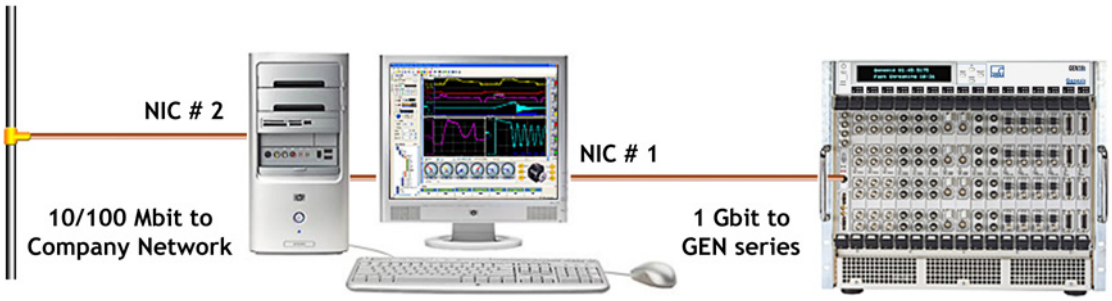


Figure 4.4: Direct connection to PC

Since NIC #1 in the illustration is not on the company network, your PC and your GEN series cannot automatically obtain network IP addresses from a server as they normally would. After a one-minute time-out period waiting for a server response, they will both assign themselves a network IP address in the range of 169.254.xxx.xxx with a subnet mask of 255.255.0.0. This is called "Automatic Private IP Addressing" and is built into Microsoft Windows. Therefore it is not necessary to make any network settings on the GEN series or your PC. **However, you must wait a minute or two after powering up the GEN series before you can communicate.** If you prefer to avoid the one minute wait, you may manually assign a fixed IP address and subnet mask in both the PC and the GEN series.

4.2.2 Connecting the GEN series to your company network

If you do not want to use a PC with two Ethernet cards, you can connect the GEN series to an Ethernet port on your local network. HBM recommends adding a 1 Gigabit autosensing Ethernet switch for this purpose. Low-cost compact switches with four to eight ports are readily available at any computer store, sufficient for connecting a number of instruments to your PC. Unlike a hub, a switch allows your PC to communicate with your instrument(s) locally with a dedicated high-speed connection, without burdening the company network with possibly high data rates. It simply plugs in and requires no network configuration.

Your network could look like Figure 4.5.

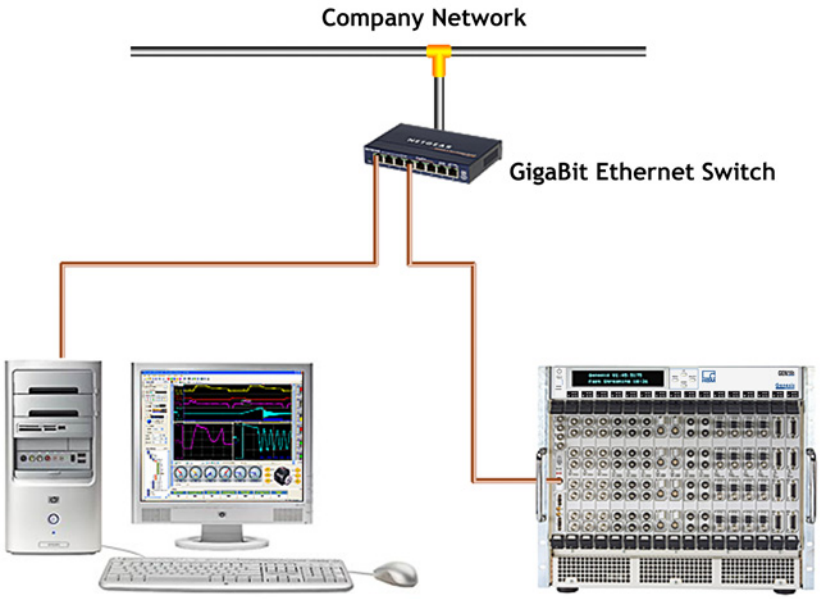


Figure 4.5: Connection to corporate network

The GEN series is pre-set for DHCP to automatically obtain a network IP address from your company server, just as your PC does. There is no need to make any network settings on the GEN series or your PC.

4.2.3 Note on IP address and DHCP

An IP address is like your telephone number or your home address -- each one is entirely unique. Every computer on the Internet or a local network has its very own IP address. The standard format is four groups of numbers separated by periods, and each number is an integer between 0 and 255.

IP addresses can be divided into two groups: static and dynamic. Computers that run important tasks all day, every day, such as servers and mail servers, have static IP addresses -- their addresses never change.

DHCP operates like any other client-server relationship. When your PC or GEN series connects to a DHCP server, the server leases the machine a private IP address. The machine lives at that address until the lease expires, at which point you are given a new IP address. When your system administrator configures your DHCP server, he can set the leases to time out at different intervals. The most common lease duration among ISPs and other large networks is three days. DHCP servers can be located within a PC or a network router.

When you want to use static IP addresses, you must set the GEN series network setting **Use DHCP** to **False**.
When there is a DHCP server you can set the GEN series network setting **Use DHCP** to **True**. For details see "Use DHCP" on page 64.

WARNING

When Use DHCP is set to False and when you are using multiple mainframes you must set a different IP address for each mainframe. For details see "Current IP address" on page 60.

4.2.4 Network testing and troubleshooting

To test your network environment:

1 If your GEN series is correctly connected to the Ethernet, the LINK LED on the front panel will illuminate within a few seconds to indicate a hardware interface is recognized. If the LINK LED does not light, your Ethernet cable is not connected or incorrectly wired (straight instead of cross-over or vice versa). Hold the two ends of the cable side by side with the retainer tab downward. A straight cable has the orange wires on the left side at both ends. A crossover cable has the orange wires on opposite sides. Also check that all eight conductors are present in the connector. Some inexpensive cables contain only four conductors. These cables are not compatible with your GEN series.

2 If the LINK LED is lit but the Perception software cannot find the GEN series system, check the TCP/IP network settings on the GEN series and on your PC. See Chapter 5 on page 53 to see how to display the GEN series IP address and mask. On your PC in Windows select Start in the task bar, click Run… and type "CMD" without quotation marks. This opens a command window. In the command window type IPCONFIG or optional IPCONFIG /ALL to view your settings. Some of the most common problems are:

- IP addresses that are not in the same range. Normally the first three octets are the same and the fourth one varies, such as 169.254.10.252 and 169.254.10.200.
- Identical IP addresses. Your PC and the GEN series must have at least one digit different in the fourth octet.
- IP addresses that use the reserved numbers 0 or 255. All digits should be between 1 and 254.
- The Subnet masks are not completely identical.

4.3 Removing and installing modules

All of the modules are removed and installed the same way. Acquisition modules can be freely interchanged and installed in any slot, A through G (A through P for 19” rack). They are automatically recognized without any configuration, jumpers or switch settings.

CAUTION

HBM uses state-of-the-art electronic components in its equipment. These electronic components can be damaged by a discharge of static electricity (ESD). Therefore, we must emphasize the importance of ESD preventions when removing or installing boards.

CAUTION

The GEN series Data Acquisition System is factory-calibrated as delivered to the customer. Swapping, replacing or removing of boards may result in minor deviations to the original calibration. The GEN series system should be tested and if necessary, calibrated, at one-year intervals or after any major event that may affect calibration. When in doubt, consult your local supplier.

CAUTION

Heatsink and other parts of the board may be hot when removed just after switch-off

4.3.1 Removing modules

To remove a module:

1 Shut down the GEN series and remove the power input cable.
2 Loosen the small set screw on both ejectors on the module:

Figure 4.6: Module ejectors with screws

3 Press the inner grey button on each ejector to release the catch.

Figure 4.7: Module ejectors

4 Press both ejectors outward to release the module. They act as levers to gently pull the module from its backplane sockets.

5 Slide the module out of the GEN series unit.

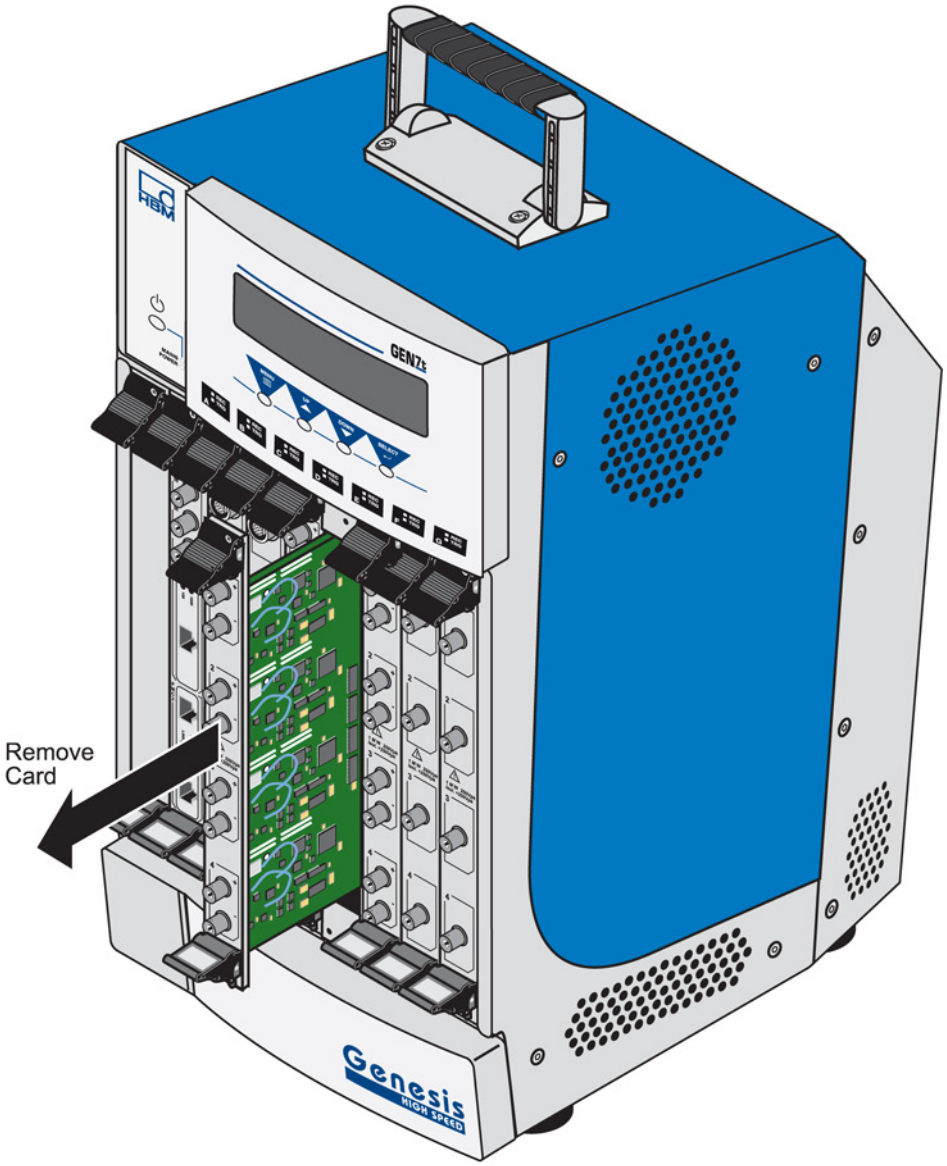


Figure 4.8: GEN7t (with removed card)

4.3.2 Installing modules

To install modules proceed as follows:

1 Shut down the GEN series and remove the power input cable.
2 Ensure the ejector levers are in the farthest outermost position, tilting away from the module.
3 Slide the module into its guide rails until the ejectors contact the perforated metal strips at top and bottom.

4 Press both ejectors inward to seat the module. They act as levers to gently pull the module into its backplane sockets.

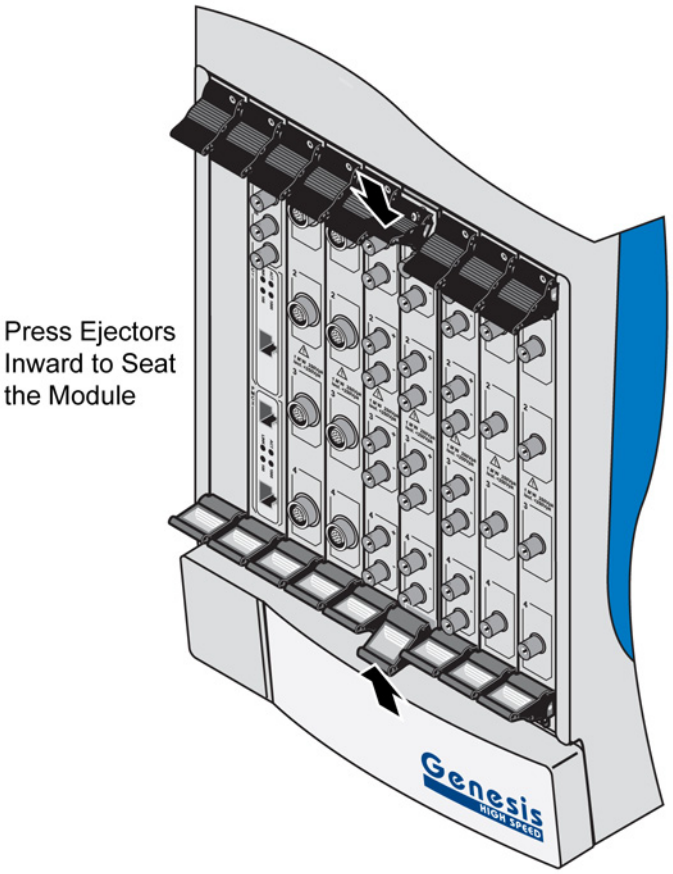


Figure 4.9: GEN7t (seating the module)

5 Using the Front Panel Controls

5.1 Introduction

The GEN DAQ systems come with firmware installed that allows you to set up the network and other functions via the local display and touch keys on the front panel of the unit. In addition to these controls, the front panel contains the Power On/Off touch key, indicators for Mains and Power for the system, and Record and Trigger indicators for each module. The GEN series rack model has a slightly different front panel layout compared to the GEN series tower model, however with the same functionality.

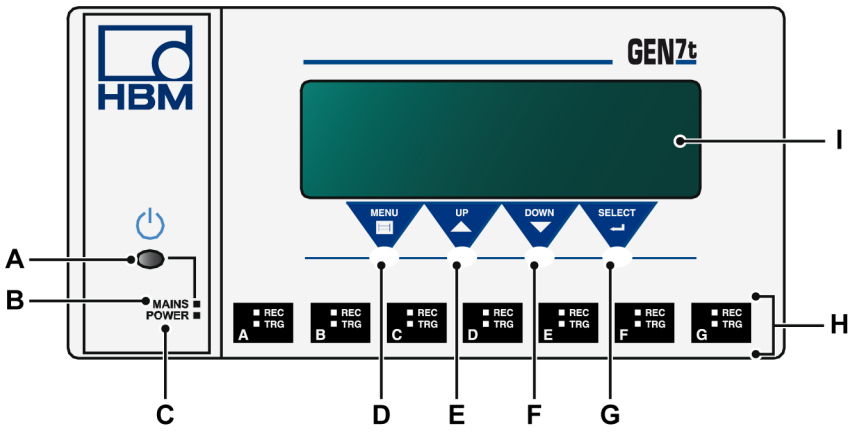


Figure 5.1: Front panel layout (tower model)

A Power On/Off

B Mains Indicator

C Power Indicator

D Menu

E Up

F Down

G Select

H Acquisition and Trigger Indicators for each Module

I Display

5.2 Using the display controls

The character display is used for network and other settings and to display system alerts such as **overtemperature**. Most settings can be made and viewed at any time. The Menu, Up, Down and Select touch keys on the front panel below the Display allow you to navigate through the software menus and enter settings for your system.

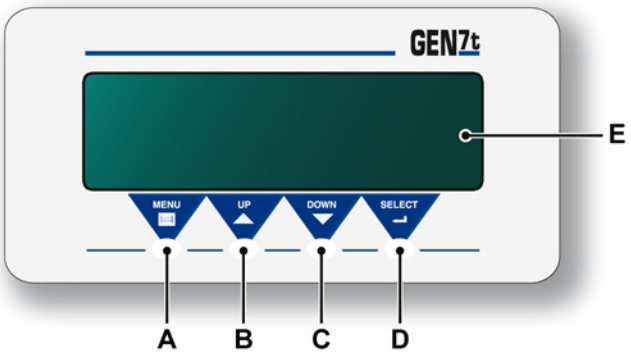


Figure 5.2: Front panel display controls (tower model)

A Menu

B Up

C Down

D Select

E Display

Normally the display shows the mainframe name and the time. Also the firmware version contained in the mainframe is shown. Whenever a PC with Perception software is connected to the system, an asterisk appears in the upper right corner to show a network connection is established.

The touch keys below the display allow you for example to set the Ethernet network properties of your system. Standard TCP/IP Ethernet requires an IP address and subnet mask to uniquely identify each network device. If you are on a company network these are normally assigned automatically by your company server. If you are connecting your system directly to your PC with a crossover cable, you must assign a suitable IP address and subnet mask before your PC can communicate with it.

5.2.1 Entering and exiting the menus

To enter the GEN series menu, briefly press the **Menu** key below the display. All network controls are located in the first menu, **Settings**. This menu is where the TCP/IP address, subnet mask and network name are entered.

To exit the GEN series menu, press **Menu** again.

From the **Settings** screen you can press the **Down** key to view the **User Info** menu. When you or another user are connected to the system through HBM's Perception software, it displays the user name and workstation that is controlling the system.

Here you can also reset the system password to the factory default.

From the **User Info** screen you can press the **Down** key to view the **Status** menu.

Here you can find information about the local disk and other options.

From the **Status** screen you can press the **Down** key to view the **Diagnose** section.

Here you can perform various diagnostic tests for your local memory and local disk (if applicable).

From the **Diagnose** screen you can press the **Down** key to view the **Alerts** section.

The Alerts section is used to read system messages.

From the **Alerts** screen you can press the **Down** key to view the **Errors** section.

The Errors section is used to read error messages.

Note *All menu changes take effect immediately on entry. There is no need to turn power off and back on after changing network settings.*

5.3 Menu: Settings

The **Settings** menu provides access to several controls for the network.

To gain access to the network settings:

1 Press the **Menu** key.
2 Press the **Select** key. Now the **Settings / Network** menu will come up.

3 Press the **Select** key again to access the various network settings.
4 As you press the **Up** and **Down** keys, you can access each of the following settings in turn.

Table 5.1: Network settings summary

MENU	FUNCTION
IPAdr	Here you can set the manual IP address (used only if DHCP is False or if a DHCP server cannot be found)
Cur IP	Displays the current IP address being used, whether manual or automatic
IPMask	Here you can set the manual IP subnet mask (used only if DHCP is False)
Cur Mask	Displays the current IP subnet mask being used, whether manual or automatic
Name	You can enter the name of the GEN series here to be used for identification on the network
Use DHCP	Selects between Automatic (TRUE) or Manual (FALSE) IP addressing
DHCPTime	When using DHCP sets the time allowed to negotiate (receive) an address from the DHCP server.
Gateway	Here you can set the IP address of your default gateway - if any. A gateway is a network point that acts as an entrance to another network
MAC Addr	The MAC (Media Access Control) address is your system's Ethernet interface unique hardware number
Port	Network port used (information only)

Just as with your PC, the network settings must be adjusted correctly or your system will not be able to communicate on the network. If you are not familiar with configuring TCP/IP Ethernet networks, we recommend you request assistance from your company's IT or network support people.

5.3.1 IP Address

This setting allows you to manually set the IP Address used by the system. IP addresses consist of four groups of digits from 1 to 254 and are used to uniquely identify each device on the network, including your system.

If you have previously selected **Use DHCP** as **TRUE**, this field will display **Automatic** as shown below and cannot be changed. In this case a server assigns the IP address and subnet mask automatically.

To set the IP address:

1. Press the **Menu** key.
2. Press the **Select** key. Now the **Settings / Network** menu will come up.
3. Press the **Select** key again to access the various network settings.
4. Press the **Up/Down** keys until you see **Network / Use DHCP** on the display.
5. Press the **Select** key to edit the settings.
6. Use the **Up / Down** key to set **Use DHCP** to **FALSE**.
7. Press the **Menu** key to return to the previous menu level.
8. Press the **Up/Down** keys until you see **IPAddr** on the display.
9. Press the **Select** key to edit the settings:

10 An underlined cursor is shown on the last digit of a triplet that you can modify. Use the **Up / Down** key to increment / decrement the triplet value.
11 Use the **Select** key to step through the triplets.
12 When done use the **Menu** key to return to the previous menu level.

The IP address consists of four numbers, each from 1 to 254. Your GEN series system and your PC must have different addresses, but within the same range, in order to communicate. HBM recommends addresses in the range of 169.254.xxx.xxx, as this is what Windows assigns itself after a one-minute time-out when no DHCP server is found.

Table 5.2: Summary of IP address assignment operation

KEY	OPERATION
Up / Down	Increments/decrements the number (triplet) above the cursor. Do not use the numbers 0 or 255 which are reserved.
Select	Moves the cursor to the next number (triplet).
Menu	Enters and confirms your selection when finished.

Note ***For system administrators:*** *APIPA (Automatic Private IP Addressing) is not supported by the GEN series. However if DHCP is TRUE and no server is found, the GEN series will revert to its manually entered address after a time-out period. If the manual address is in the range of 169.254.xxx.xxx with mask of 255.255.0.0, the practical effect is similar to APIPA.*

5.3.2 Current IP address

This screen is for information only. It displays the actual IP address currently in use to provide both a confidence check and network troubleshooting. When **Use DHCP** is set to **FALSE**, it displays the IP address you set manually. When **Use DHCP** is set to **TRUE**, it displays the IP address your server has assigned and confirms the communication was successful.

5.3.3 IP Mask

This setting allows you to manually set the IP Mask (subnet mask) used by the system. IP masks consist of four groups of digits (usually 0 or 255) and are used to indicate which devices on the network can communicate with each other. Your system and your PC must have exactly the same mask to communicate properly.

If you have previously selected **Use DHCP** as **TRUE**, this field will display Automatic as shown below and cannot be changed. In this case a server assigns the IP address and mask automatically.

To set the IP Mask:

1. Press the **Menu** key.
2. Press the **Select** key. Now the **Settings / Network** menu will come up.
3. Press the **Select** key again to access the various network settings.
4. Press the **Up/Down** keys until you see **Network / Use DHCP** on the display.
5. Press the **Select** key to edit the settings.

6 Use the **Up / Down** key to set **Use DHCP** to **FALSE**.
7 Press the **Menu** key to return to the previous menu level.
8 Press the **Up/Down** keys until you see **IPMask** on the display.
9 Press the **Select** key to edit the settings:

10 An underlined cursor is shown on the last digit of a triplet that you can modify. Use the **Up / Down** key to increment / decrement the triplet value.
11 Use the **Select** key to step through the triplets.
12 When done use the **Menu** key to return to the previous menu level.

The IP mask consists of four numbers, usually either 255 or 0. Your GEN series and your PC must have exactly the same Mask in order to communicate properly.

Table 5.3: Summary of IP mask assignment operation

KEY	OPERATION
Up / Down	Increments/decrements the number (triplet) above the cursor. In most cases only values of 255 or 0 are used.
Select	Moves the cursor to the next number (triplet).
Menu	Enters and confirms your selection when finished.

5.3.4 Current IP Mask

This screen is for information only. It displays the actual IP Mask (subnet mask) currently in use to provide both a confidence check and network troubleshooting. When **Use DHCP** is set to **FALSE**, it displays the Mask you set manually. When **Use DHCP** is set to **TRUE**, it displays the Mask your server has assigned and confirms the communication was successful.

5.3.5 Network name

This control allows you to set the **Network Name** of your system. The Perception software uses this name to identify the system in its menus and sheets. You can enter any name that has significance to you or simply leave the default name in place. If you have multiple GEN series mainframes, you must give each a unique name so you can easily tell them apart in the menus.

Note *This name is used only by Perception software. It does not appear in the Windows "Network Places" listing.*

To modify the network name proceed as follows:

1. Press the **Menu** key.
2. Press the **Select** key. Now the **Settings / Network** menu will come up.
3. Press the **Select** key again to access the various network settings.
4. Press the **Up/Down** keys until you see **Network / Name** on the display.
5. Press the **Select** key to edit the settings:

6. An underlined cursor is shown on the first character that you can modify. Use the **Up / Down** key to step through the available (special) characters.
7. Use the **Select** key to step through the characters.
8. When done use the **Menu** key to return to the previous menu level.

The name you enter can be up to 32 characters long.

Table 5.4: Summary of network name assignment operation

KEY	OPERATION
Up / Down	Increments/decrements the character above the cursor. Hold the key down to scroll quickly through the choices. Available characters are A-Z, a-z, 0-9 and space.
Select	Moves the cursor to the next position.
Menu	Enters and confirms your selection when finished.

5.3.6 Use DHCP

To set up the system for network communication, your first selection must be whether DHCP (Dynamic Host Configuration Protocol) will be used to automatically manage IP addresses.

To modify the DHCP setting:

1 Press the **Menu** key.
2 Press the **Select** key. Now the **Settings / Network** menu will come up.
3 Press the **Select** key again to access the various network settings.
4 Press the **Up/Down** keys until you see **Network / Use DHCP** on the display.
5 Press the **Select** key to edit the settings:

6 Use the **Up / Down** key to step through the possible options.
7 Press the **Menu** key to enter your selection when you are finished. The display will show your selection.

If you are on a company network, select **TRUE**. Most company networks provide a DHCP server, which will automatically assign your system a suitable IP address and subnet mask. Check with your IT department is you are not sure. If DHCP is used there is no need to make any further network settings.

If you are connecting the system directly to your PC and there is no server available, select **FALSE**. This might be the case if you are making measurements in the field or in a test bay without network access. You must then assign compatible IP addresses and subnet masks on both the GEN series system and on your PC. Use the **IP Address** and **IP Mask** menus to do this in the GEN series.

5.3.7 DHCP search time

Set the time allowed by the GEN series system to negotiate for an IP-address.

To modify the DHCPTime setting:

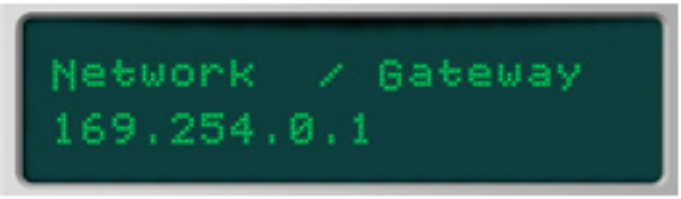
1. Press the **Menu** key.
2. Press the **Select** key. Now the **Settings / Network** menu will come up.
3. Press the **Select** key again to access the various network settings.
4. Press the **Up/Down** keys until you see **Network / DHCPTime** on the display.
5. Press the **Select** key to edit the settings:

6. Use the **Up / Down** key to step through the possible options.
7. Press the **Menu** key to enter your selection when you are finished. The display will show your selection.

Set the time you allow the system to negotiate (receive) an IP-address from a DHCP server. Select **Short** for approximately 15 seconds, select **Medium** for approximately 30 seconds and **Long** for approximately 60 seconds.

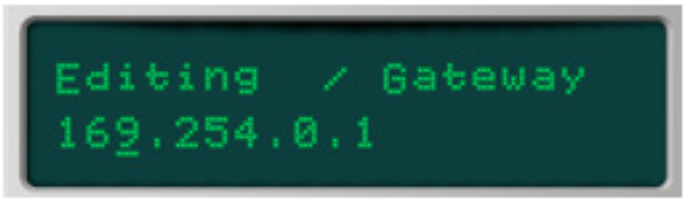
5.3.8 Gateway

This setting allows you to manually set the IP Address of your **Gateway**. A gateway is a network point that acts as an entrance to another network. In the network for an enterprise, a computer server acting as a gateway is often also acting as a proxy server and a firewall server. When you are not sure about your gateway (if any), you should contact your system administrator.



To set the Gateway IP address:

1 Press the **Menu** key.
2 Press the **Select** key. Now the **Settings / Network** menu will come up.
3 Press the **Select** key again to access the various network settings.
4 Press the **Up/Down** keys until you see **Network / Gateway** on the display.
5 Press the **Select** key to edit the settings.



6 An underlined cursor is shown on the last digit of a triplet that you can modify. Use the **Up / Down** key to increment / decrement the triplet value.
7 Use the **Select** key to step through the triplets.
8 When done use the **Menu** key to return to the previous menu level.

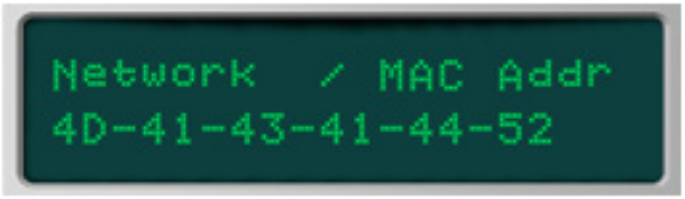
The IP address consists of four numbers, each from 1 to 254.

Table 5.5: Summary of Gateway IP address assignment operation

KEY	OPERATION
Up / Down	Increments/decrements the number (triplet) above the cursor. Do not use the numbers 0 or 255 which are reserved.
Select	Moves the cursor to the next number (triplet).
Menu	Enters and confirms your selection when finished.

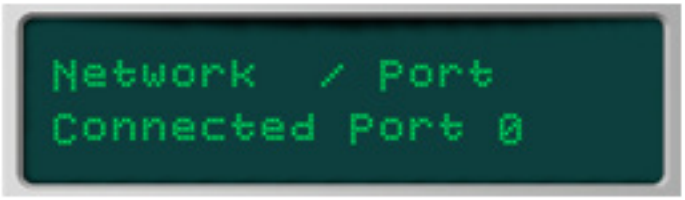
5.3.9 MAC Address

This setting presents information only and has no controls. In a local area network (LAN) or other network, the **MAC (Media Access Control) address** is your system's Ethernet interface unique hardware number. When you're connected to the Internet from your system (or host as the Internet protocol thinks of it), a correspondence table relates your IP address to your system's physical (MAC) address on the LAN.



5.3.10 Port

The port setting here is for service information only.



5.4 Menu: User Info

The **User Info** menu provides information and allows you to reset the system password. It allows you to view the user name and computer name that are controlling the GEN series DAQ system.

To gain access to the User Info:

1 Press the **Menu** key.
2 Press the **Up / Down** key until the **Menu / User Info** comes up:

3 Press the **Select** key to access the various **User Info** settings.
4 As you press the **Up** and **Down** keys, you can access each of the following settings in turn.

Table 5.6: User Info settings summary

MENU	FUNCTION
UserName	When a PC with Perception software is currently connected to the GEN series, the PC user name from the Windows Logon screen is shown.
Station	When a PC is connected the station name is displayed, this is the same name Windows uses to identify the computer in the Network Places listing.
ResetPwd	Use this entry to reset the system password.

5.4.1 User name

If the system is powered but idle, the **User Name** screen displays **Not Connected**. If a PC with Perception software is currently connected to the system, the PC user name from the Windows Log-on screen is shown. This is useful to inform you who is using the system at present, and also to confirm that Perception's software connection and log-on to the system was successful.

5.4.2 User station

In addition to the **User Name**, the system can also display the network name of the PC workstation that is currently connected. The workstation name (**Station**) is the same name Windows uses to identify the computer in the Network Places listing. The message **Not Connected** indicates no one is connected to the system at present.

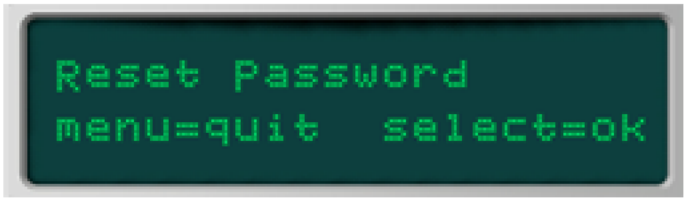
5.4.3 Reset password

Network access to the GEN series data acquisition system is password protected. By default this password is “genesis” for a GEN series system. You can modify this password only through the Perception software.

To reset the password to the factory default proceed as follows:

1. Press the **Menu** key.
2. Press the **Up / Down** key until the **Menu / User Info** comes up.
3. Press the **Select** key to access this menu.
4. Press the **Up / Down** key until the **User Info / ResetPwd** comes up:

5 Press **Select.** You are now presented two options:



6 Press **Select** to choose **ok** to reset the password, or **Menu** to **quit** and abort this process. When cancelled, the current password remains in effect.

7 Click **Menu** twice to exit the menu.

5.5 Menu: Status (IM1)

The **Status** menu provides information about network transfer speed as well as local disk usage. When a local disk is available you can format this disk. A local disk can be connected to the GEN series through an optional SCSI interface.

Note *IM2 has a built in disk*

To gain access to the Status:

1 Press the **Menu** key.
2 Press the **Up / Down** key until the **Menu / Status** comes up:

3 Press the **Select** key to access the various status settings.
4 As you press the **Up** and **Down** keys, you can access each of the following settings in turn.

Table 5.7: Status settings summary

MENU	FUNCTION
Version	Firmware version.
DateTime	Current system date and time.
SyncSrc	Synchronization source for internal clock.
Speed	This setting informs about the transfer speed capabilities over the Ethernet.
LocDisk	This menu item informs about the status of a local hard disk drive.
TotSize	When a local disk is available, this item informs about the disk size.
SCSIMODE	Informs about the SCSI mode of the connected drive.
Disk	Type of internal disk (IM2 only)
Format	Allows you to quick format the drive.

5.5.1 Version

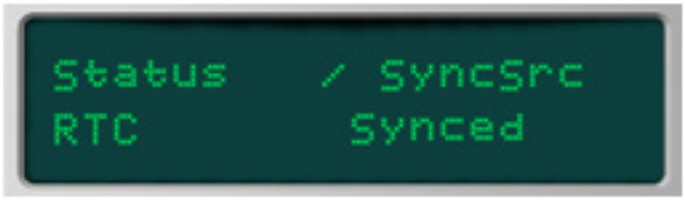
The **Version** menu item informs about the currently installed firmware version.

5.5.2 DateTime

The **DateTime** menu item informs about the current system date and time. Depending on the selected synchronization source (see next section) the date and time are controlled by either the PC, or an installed IRIG or IRIG/GPS card.

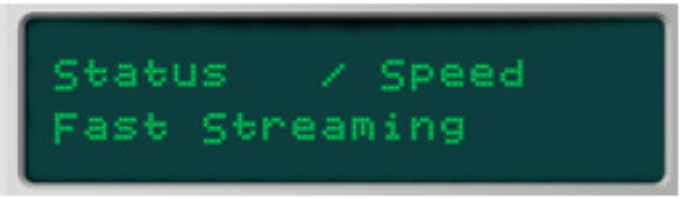
5.5.3 SyncSrc

The **SyncSrc** menu item informs about the currently selected synchronization source for the internal clock. Depending on the selected synchronization source the date and time are controlled by either the PC (**RTC**), or an installed IRIG (**IRIG**) or IRIG/GPS (**GPS**) card. The system can be either synchronized (**Synced**), not synchronized (**Not Synced**) or trying to synchronize (**Syncing**). The source is selected in Perception (settings sheet).



5.5.4 Speed

The **Speed** menu item informs about the transfer speed capabilities over the Ethernet. As standard the speed is set to **Standard**. When the additional option is installed, the speed is set to **Fast Streaming**.



5.5.5 LocDisk (IM1)

The **LocDisk** (Local Disk) menu item informs about the status of a local hard disk drive. A local hard disk can be connected to the GEN series system when the optional SCSI interface is installed or when the IM2 is installed.

When available the status is set to **DiskAvailable**.

Other status messages are:

Table 5.8: Status messages

MESSAGE	MEANING
Disk Available	Storage drive connected
NoDrive	No drive connected
NotFormatted	Disk is not formatted or formatted in an unknown format.
WrongFormat	The disk is formatted, but not using a 512 byte sector size.

5.5.6 TotSize

The **TotSize** (total size) menu item informs about the total size of the local hard disk in Bytes. E.g. the display below shows **133 939 200** Bytes which equals 130 800 (binary) KiloBytes or (binary) 127.7 MegaBytes.

Note *Hard disk drive manufacturers state capacity in decimal units. Since most computer operating systems report drive usage and capacity in binary units, the difference causes an apparent loss between the advertised capacity and the formatted, usable capacity.*

Modern-day PC users, of course, regard both RAM and disk as kinds of storage and expect their capacities to be measured in the same way. Operating systems usually report disk space using the binary version. To the purchaser of a "30 GB" hard drive, rather than reporting either "30 GB", Microsoft Windows reports "28 GB".

5.5.7 SCSIMODE (IM1)

The **SCSIMODE** menu item informs about the transfer mode used by the SCSI drive interface. This mode depends on the SCSI interface of the hard disk drive. Refer to the specifications of the interface for details.The GEN series interface supports up to Ultra 320 SCSI.

Typical supported modes include:

- Ultra 160 SCSI (**SCSI160**): 160 MByte/s on a 16-bit (wide) bus
- Ultra 320 SCSI (**SCSI320**): 320 MByte/s on a 16-bit (wide) bus

When the connected drive has an interface less than Ultra 320 SCSI, an alert is generated. For details see “Menu: Alerts” on page 83.

5.5.8 Disk (IM2)

The **Disk** menu item informs you about the type of internal disk installed.

5.5.9 Format (IM2)

You can quick format the internal drive using the **Format** command. **This allows you to erase all data without connecting to a PC.**

To format the connected drive proceed as follows:

1. Press the **Menu** key.
2. Press the **Up/Down** key until the **Menu/Status** comes up.
3. Press the **Select** key to access this menu.
4. Press the **Up/Down** key until the **Status/Format** comes up:

5 Press **Select.** You are now presented two options:

6 Press Select to choose **ok** to format, or **quit** to abort this process. After confirmation the system will reboot.

HINT/TIP

The drive is formatted using the internal firmware of the SCSI interface. When the disk is used only together with the GEN series this imposes no problems. However, when you use this disk also in combination with a PC, HBM advises to format the disk only through the PC's operating system.

5.6 Menu: Diagnose

The **Diagnose** menu gives you access to a variety of tests that allow you to verify correct operation and integrity of your storage devices: internal RAM on each board and local disk (when available).

To gain access to the Diagnose menu proceed as follows:

1 Press the **Menu** key.
2 Press the **Up / Down** key until the **Menu / Diagnose** comes up:

3 Press the **Select** key to access the various functions.
4 As you press the **Up** and **Down** keys, you can access each of the following settings in turn.

Table 5.9: Diagnose functions summary

MENU	FUNCTION
Memtest	Test RAM memory on each module
DiskPerf	Test disk performance (throughput) of local disk when available
DiskItg	Test disk integrity of local disk when available **WARNING: this will erase all data on your local GEN series system disk!**

5.6.1 Memory test

The **MemTest** function tests the on-board memory of a selected module.

To perform a memory test:

1 Press the **Menu** key.
2 Press the **Up / Down** key until the **Menu / Diagnose** comes up.
3 Press the **Select** key. Now the **Diagnose / Memtest** option will come up.
4 Press the **Select** key to start the memory test function.
5 Press the **Up / Down** key to select another module.

When you select this option, the display shows:

- Current status
- Previous result
- Up/down arrows to step through the available modules

Status messages can be:

Table 5.10: Status messages (Part 1)

MESSAGE	MEANING
Module ‘n’ Not Tested	So far no test has been performed.
Module ‘n’ Waiting	Memory test wants to start, but can’t. Typically because an acquisition (recording) is active. Check the Acquisition indicator of the specific module.
Module ‘n’ Running	Test is busy

When available the result of the previous test is shown.

At the end of the test one of the following messages is displayed:

Table 5.11: Status messages (Part 2)

MESSAGE	MEANING
Module ‘n’ Succeeded	Memory test passed. No problems detected.
Module ‘n’ Failed	Memory test failed. Consult HBM technical support for options.

Press the **Up / Down** key to test another module or press the **Menu** key to return to the **Menu / Diagnose** menu.

5.6.2 Disk performance

The **DiskPerf** function tests the performance of the local SCSI disk when available. The result is expressed in MegaBytes per second as an indication of the possible throughput. This result is obtained by performing a mix of read and write operations, both random and sequential.

To perform a disk performance test:

1. Press the **Menu** key.
2. Press the **Up / Down** key until the **Menu / Diagnose** comes up.
3. Press the **Up / Down** key until you see the **Diagnose / Diskperf** option.
4. Press the **Select** key to start the disk performance test

5. While active you can press the **Select** key to abort the process:

6. When ready the result is displayed:

7 Press the **Select** key to start the test again or press the **Menu** key to return to the menu.

The result can be one of the following messages:

Table 5.12: Status messages (Part 3)

MESSAGE	MEANING
xx MB/s	Disk test passed. Average throughput is displayed in MegaBytes per second.
DskFull	Disk test failed due to a full disk. Remove some data files to create space for temporary files.
AcqBusy	Disk test failed because an acquisition was active or has been started while testing. This also includes Pause mode.
TimeOut	Test is taking too long. Probably the disk speed is too low.
Failed	Any other (read/write) error has been encountered. Use the DiskItg test to verify. Save your data before doing so.

5.6.3 Disk integrity

WARNING

Before you start to use the DiskItg function make sure you have made a backup of all your data! DskItg will erase the complete local SCSI disk.

IMPORTANT

This test will take a long time to complete. Depending on your disk size this test may take up several hours.

The **DiskItg** function serves two purposes:

- Verify the local disk integrity.
- Create a fresh directory structure for recordings.

This function first erases all data, and then fills the complete disk with files with known data patterns. These files are then read back and verified. Finally a blank new directory structure for data files is created.

To perform a disk integrity test:

1 Press the **Menu** key.
2 Press the **Up / Down** key until the **Menu / Diagnose** comes up.
3 Press the **Up / Down** key until you see the **Diagnose / DiskItg** option.
4 Press the **Select** key to enter the disk performance test:

5 From here you first need to confirm the operation: press the **Menu** key to **start** the operation or press the **Select** key to select **no** and abort the operation and return to the menu. Once confirmed the test starts. A percentage indicator gives an idea of the progress.

You can press the **Select** key to **abort** the process. This will complete the process in a proper way.

6 When the process is complete the result is displayed:

7 Press the **Select** key to start the test again or press the **Menu** key to return to the menu.

The result can be one of the following messages:

Table 5.13: Status messages (Part 4)

MESSAGE	MEANING
Succeed	Disk integrity test passed.
AcqBusy	Disk test failed because an acquisition was active or has been started while testing.
ReadErr	A read error has been encountered
WrtErr	A write error has been encountered
VfyErr	A verification error has been encountered
InitErr	Could not empty the disk initially
RestErr	Could not remove test files and create new directory
TimeOut	Test is taking more than eight (8) hours
Failed	Any other error has been encountered.

5.7 Menu: Alerts

The **Alerts** menu provides information on various topics.

To gain access to the **Alerts** information, proceed as follows:

- Press the **Menu** key.
- Press the **Up / Down** key until the **Menu / Alerts** comes up:

- Press the **Select** key to access the various messages.
- Press **Menu** twice to quit.

The following is a list of possible alerts:

Table 5.14: Alert messages

MESSAGE	PROBLEM
Module Version Error	Boards are installed with incompatible firmware versions. Contact your local dealer or visit the HBM website.
SCSI Mode Error	This message is displayed when the connected SCSI drive has a lower transfer speed than the interface supports. E.g. a SCSI160 drive is connected to the GEN series SCSI320 interface. This will lead to a decrease of throughput and published specifications may not be met. You can find the current mode in the **Status / SCSIMODE** section.
Network Speed xxx MB	The current network speed is lower than the interface supports. E.g. 100 MB/s for the GEN series 1 Gbit/s interface. This will lead to a decrease of throughput and published specifications may not be met.

5.8 Menu: Errors

The **Errors** menu provides error information.

To gain access to the Errors information proceed as follows:

- Press the **Menu** key.
- Press the **Up / Down** key until the **Menu / Errors** comes up:

- Press the **Select** key to access the various messages.
- Press **Menu** twice to quit.

The following is a list of possible errors:

Table 5.15: Error messages

MESSAGE	PROBLEM
Overtemp X/Y value	High temperature: X = slot number Y = element/component value = value, e.g. 70.5 C
Overvolt X/Y value	High voltage: X = slot number Y = element/component value = value, e.g. 24.27 V
Undrvolt X/Y value	Low voltage: X = slot number Y = element/component value = value, e.g. 0.22 V

The element/component number is an integer value in range 0 through 17, and for service purposes only.

5.9 Power control and indicators

The GEN series remains in a low-power standby state whenever power is applied. The "Mains" indicator being lit indicates this state.

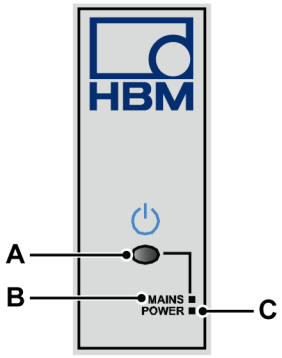


Figure 5.3: Front panel power controls

A Power On/Off

B Mains Indicator

C Power Indicator

To turn power ON, briefly press the **Power On/Off** button. After about a minute, the display will report that GEN series is **Ready** or **Fast Streaming**.

To turn power OFF, again, briefly press the **Power On/Off** button. The display will request confirmation:

Briefly press the **Select** button to **Confirm**, to complete the shutdown procedure.

HINT/TIP

In the rare event that the GEN series stops responding, such as might be the case if the network connection is lost during a communication, power can be forced off by holding the Power On/ Off button down for five seconds.

5.10 Module indicators

For each acquisition module there are two LEDs to inform you of its status at a glance. The tower model has 7 groups of indicators, the rack version provides 16 groups of indicators.

Figure 5.4: Front panel module indicators (tower model)

If both LEDs are off, the module is in an idle or signal monitoring state without recording.

The REC LED indicates the module is currently recording data, either pre-trigger or posttrigger.

The TRIG LED additionally indicates the module has recognized a valid trigger, and is now collecting post-trigger data.

5.11 Front panel display and control overview

GEN series 7t and 16t front panel display and control overview

Settings / Network menu		
Sub menu	**Setting**	**Value**
IpAddr	IP address	Automatic xxx.xxx.xxx.xxx
Cur IP	Current IP address	xxx.xxx.xxx.xxx
IpMask	IP address mask	Automatic xxx.xxx.xxx.xxx
Cur Mask	Current IP address mask	xxx.xxx.xxx.xxx
Name	System name	<literal text>
Use DHCP	Use DHCP	TRUE FALSE
DHCPTime	Negotiation time	Short Medium Long
Gateway	Gateway IP address	xxx.xxx.xxx.xxx
MAC Addr	Interface MAC address	## - ## - ## - ## - ## - ##
Port	Front panel port	n

For more information please refer to "Menu: Settings" on page 58.

UserInfo menu		
Sub menu	**Setting**	**Value**
UserName	Name of system user	Not connected <literal text>
Station	Name of system controller	Not connected <literal text>
ResetPwd	Reset password	quit ok

For more information please refer to "Menu: User Info" on page 68.

Status menu		
Sub menu	**Setting**	**Value**
Version	Firmware version	M.mm.bbbbb
DateTime	Current date and time	dd mmm yyyy

Status menu		
Sub menu	**Setting**	**Value**
SyncSrc	Synchronization source	RTC + <sync> IRIG + <sync> GPS + <sync> <source>+ Synced <source>+ Not Synced <source> + Syncing
Speed	Data transfer speed	Standard Fast Streaming
LocDisk	Local Disk status	DiskAvailable NoDrive NotFormatted WrongFormat
TotSize	Total size of disk	<numeric value>
SCSIMODE	Type of SCSI mode	SCSI160 SCSI320
Disk	Type of internal disk	SATA 1.5
Format	Format internal disk	Disk Format Busy

For more information please refer to "Menu: Status (IM1)" on page 71.

Diagnose menu		
Identifier	**Full name / Description**	**Functions**
Memtest	Memory test results	Module n Waiting | <info> Module n Running | <info> Module n Succeeded <date> Module n Failed <date> <status active> Previous:Succeeded <status active> Previous:Failed <status result> dd mmm yyyy hh:mm
DiskPerf	Disk performance	BUSY <numeric value> MB/s DskFull AcqBusy Timeout Failed

Diagnose menu		
Identifier	**Full name / Description**	**Functions**
DiskItg	Test disk integrity	None Timeout Succeed AcqBusy ReadErr WrtErr VfyErr InitErr RestErr Failed

For more information please refer to "Menu: Diagnose" on page 77.

Alerts menu		
Sub menu	**Setting**	**Value**
	Warning messages	Module Version Error SCSI Mode Error Network Speed xxx MB

For more information please refer to "Menu: Alerts" on page 83.

Errors menu		
Sub menu	**Setting**	**Value**
	Error messages	Overtemp X/Y <value> Overvolt X/Y <value> Undervolt X/Y<value>

For more information please refer to "Menu: Errors" on page 84.

6 Input Modules

6.1 Available input modules

At printing time of this document the following input modules were available:

- The **Basic Amplifier** input module gives you 8 channels with single-ended or isolated input on one board. With 200 kS/s or 1 MS/s digitizing rate at 16-bit resolution they are ideally suited for high definition transient recording.
- The **Basic XT module** gives you all the features of the basic amplifier, plus isolation, plus unbalanced differential inputs and input ranges up to ± 100 V.
- The 200 kS/s and 1 MS/s **Bridge Amplifier** versions comprise everything that you would expect from HBM. They offer isolated and differential inputs, high gain, and extremely good SNR even at the maximum 400 kHz bandwidth. Both versions come with on-board, software selectable shunt calibration and bridge completion resistors, a bridge wizard for error-free setup and fast auto balance.
- The unique high-end **Universal Amplifier** serves a variety of needs, ranging from differential and/or isolated measurements to IEPE-based vibration or shunt-based current measurements. Apart from the differential mode, the amplifier supports any type of 'constant current' vibration and acceleration sensors. In “current mode” the built-in shunt can be used to measure up to 1 ampère in a safe, isolated and fused manner, without the need of external shunt resistors.
- As a special input board, the **Binary Marker** input enables up to 64 "digital" channels to be recorded as well. This board can be used to record status signals from the process or test like high/low, open/closed or left/right. In addition 3 counter/timer channels are available.
- The **Binary Marker HV** board allows you to acquire 32 digital event signals (markers) as well as 8 digital event signals that are optically isolated. Although general purpose, this board is specifically suited for the medium/ high voltage market. More details can be found in the BE3200 manual.
- **Master Slave** Technically speaking the master/slave card is not an input card. It is used for fully synchronous operation between multiple mainframes. The master/slave card synchronizes clocks, triggering, pause/ stop and start signals between all connected mainframes. Connections are made using fiber-optic cables.
- **16/32 Channel Accel Card** These cards have been developed for use in the five following application areas:
  As a differential amplifier or non-isolated entry level electrical input amplifiers. In Accelerometer mode they offer inputs for an array of IEPE based sensors. In Charge mode they can be used directly with charge type sensors. In Single ended mode the cards can serve as coupler inputs for preconditioned signals.

- For ultra fast signals, the **25 MS/s and 100 MS/s high speed digitizers** are equipped with four channels sampling at incredible high speed. With selectable anti-aliasing filtering and 14-bit (100 MS/s) or 15-bit resolution (25 MS/s), these inputs turn the GEN5i into an extremely fast transient recorder. Enhanced resolution mode increases input resolution for both models to 16-bit. Inputs are single ended or differential. The 25 MS/s digitizer replaces the 20 MS/s high speed digitizer that was produced before 2007.

Table 6.1: Available acquisition boards with signal conditioning

MODEL	INPUT TYPE	ISO	Fs	BITS	MEMO-RY	CHAN'S
Basic200	Single Ended	no	200 kS/s	16 bit	64 MS	8
Basic1M	Single Ended	no	1 MS/s	16 bit	128 MS	8
Basic1M iso	Unbalanced Diff	yes	1 MS/s	16 bit	256 MS	8
BasicXT200 iso	Unbalanced Diff	yes	200 kS/s	16 bit	64 MS	8
BasicXT1M iso	Unbalanced Diff	yes,	1 MS/s	16 bit	256 MS	8
Accel 16-250k*	Diff/IEPE/ Charge	no	250 kS/s	16/24 bit	1 GS/ 512 MS	16
Accel 32-250k*	Diff/IEPE/ Charge	no	250 kS/s	16/24 bit	1 GS/ 512 MS	32
Bridge200 iso	Bridge / Diff	yes	200 kS/s	16 bit	64 MS	4
Bridge1M iso	Bridge / Diff	yes	1 MS/s	16 bit	256 MS	4
Uni200 iso	Diff / IEPE / Shunt	yes	200 kS/s	16 bit	64 MS	4
Uni1M iso	Diff / IEPE / Shunt	yes	1 MS/s	16 bit	256 MS	4
HiSpeed25M	SE / Diff	no	25 MS/s	15 bit	64 MS	4
Hi-Speed100M	SE / Diff	no	100 MS/s	14 bit	400 MS	4
Marker1M	Binary	no	1 MS/s	1 bit	512 MB	64
Marker1M-HV	Binary	yes/no	1 MS/s	1 bit	512 MB	8/32

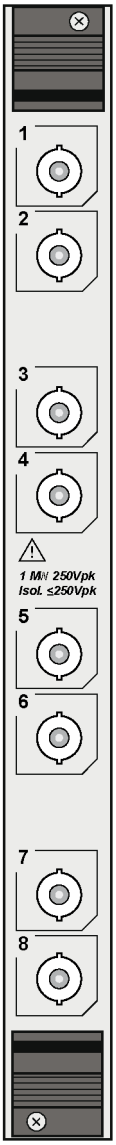
Table 6.2: Acquisition boards under development (Preliminary)

MODEL	INPUT TYPE	ISO	Fs	BITS	MEMORY	CHAN'S
Basic 16-20k	Diff	no	20 kS/s	16 bit	100 MS/ 200 MB	16

MODEL	INPUT TYPE	ISO	Fs	BITS	MEMORY	CHAN'S
Basic 32-20k	Diff	no	20 kS/s	16 bit	100 MS/ 200 MB	32
HV200k	Diff	1 kV	200 kS/s	18 bit	512 MS	6
HV2M	Diff	1 kV	2 MS/s	18 bit	512 MS	6

(*) Includes TEDS support

6.2 Basic amplifier input module



The GEN series basic amplifier input module has a general purpose signal conditioner for use with voltage inputs, externally conditioned signals or oscilloscope probes.

The basic signal conditioner provides eight channels of single-ended BNC voltage inputs from 2 V to 100 V full scale with full offset and auto-zero capability. Every channel is equipped with an independent full-range input amplifier, 7-pole Bessel anti-alias filter, 16-bit Analog-to-Digital converter operating at up to 1 MS/s and several selections of digital filtering. A 200 kS/s model is available for medium speed acquisition requirements.

On board memory ranges from 64 MegaSample (128 MegaByte) to 256 MegaSamples (512 MegaByte). The memory is shared by enabled channels.

Each channel also features two set-points for trigger or alarm purposes plus hardware status detection to instantly identify any channel that exceeds full scale. All channels are synchronously sampled at full speed with no multiplexing and almost immeasurable crosstalk. The model uses standard metal BNC connectors, whose shells are connected to earth ground. The inputs are 1 MΩ impedance and are compatible with standard oscilloscope multiplier probes.

The 1 MS/s basic amplifier input module is also available in an isolated version with plastic BNC connectors.

6.2.1 Basic 200K 1M Digitizer

Capabilities Overview		
Component	**Value**	
	BASIC 200K Digitizer	**BASIC 1M Digitizer**
Sample rate max	200 kS/s	1 MS/s
Memory per card	64 MS (128 MB)	128 MS (256 MB)
Analog channels	8	8
ADC resolution	16 bit (0.0015 %)	16 bit (0.0015 %)
Input type	Single ended	Single ended

General Specifications

Analog Input Section		
Component	**Unit Description**	**Value**
Channels		8
Type		Single ended
Connectors	Metal type BNC, outer shell grounded	
Ranges	Plus variable gain in 1000 steps (0.1 %)	± 1.0 V, ± 2.0 V, ± 5.0 V,± 10 V, ± 20 V, ± 50 V
Offset	1000 steps	0.1 %
Coupling	± 1 % full scale	DC, GND
Impedance		1 MΩ
Maximum Static Error		0.1 % full scale
Noise		0.02 % full scale
Overload protection		250 Volt
Number of slots	Including signal conditioners	1

Analog to Digital Conversion		
Component	**Value**	
Model	**BASIC 200k Digitizer**	**BASIC 1M Digitizer**
Sample rate	0.1 S/s to 200 kS/s	0.1S/s to1 MS/s
ADC resolution	16 bit (0.0015 %)	
Timebase accuracy	50 ppm	
Filter	Bessel or Butterworth	Bessel or Butterworth

Analog to Digital Conversion			
Component		**Value**	
Wideband bandwidth		20 kHz @-3 dB	500 KHz @ -3 dB
Bessel/butterworth filter specifics			
	Analog anti-aliasing	Time- or Frequency domain optimized	Bypass, Time, Frequency-domain optimized
	Time Domain	7-pole Bessel, optimal step response	
		20 kHz	220 kHz
	Frequency Domain	7-pole Butterworth, extended frequency response	
		20 kHz	370 kHz
IIR or FIR filter specifics			
	Digital	Off, Frequency domain optimized	
	Frequency	6-pole Bessel style IIR, sample rate divided by: 10, 20, 40, 100	12-pole FIR at sample-rate divided by: 4, 10, 20, 40
	Digital IIR	Off time domain optimized	
	Frequency	6-pole digital Bessel at sample-rate divided by: 10, 20, 40, 100	

On-board Memory		
Component	**Value**	
Model	**BASIC 200K Digitizer**	**BASIC 1M Digitizer**
Per card (shared by enabled channels)	64 MS (128 MB)	128 MS (256 MB)
Per channel (with all 8 channels used)	8 MS	16 MS

Triggering		
Component	**Unit Description**	**Value**
Channel trigger	Each channel has individual dual-level trigger detection with selectable hysteresis, modes and qualifiers	1
Pre- and post-trigger length		0 to full memory
Trigger rate	Up to 400 triggers per second, zero re-arm time	1 per 2.5 ms

Triggering			
Component		**Unit Description**	**Value**
Trigger total		Total number of triggers per recording	10,000
Resolution		For each level	16 bit (0.0015 %)
Hysteresis		Defines the trigger insensitivity	0.1 to 100 % of Full Scale
Cross channel triggering		Analog triggers of all channels	Logical OR
		Qualifiers of all channels	Logical AND
Analog trigger modes			
	Basic	Single level	Pos or neg crossing
	Dual Level	Two individual levels, OR-ed	One pos and one neg crossing
Analog qualifier modes			
	Basic	Arm the acquisition with a single level	Pos or neg crossing
	Dual (level)	Arm the acquisition with two individual levels, OR-ed	One pos and one neg crossing

Real-time Analysis	
Component	**Description**
StatStream ©	Each channel includes real-time extraction of Max, Min, Mean, Peak-to- Peak, and RMS values

Acquisition Modes	
Component	**Description**
Sweeps	Triggered acquisition to RAM without sample rate limitations; for single or repetitive transients or intermittent phenomena.
Continuous	Direct storage to PC or mainframe hard disc without file size limitations; triggered or un-triggered; for long duration recorder type applications with up to 1 MS/s rate per channel; (maximum aggregate rate pending from mainframe configuration and PC).
Dual	Combination of Sweeps and Continuous; recorder type streaming to hard disc with simultaneously triggered sweeps in RAM.
Slow fast sweep	A triggered acquisition in RAM which includes an acquisition phase with a higher sample rate, located at a point of interest.

Storage Modes	
Component	**Description**
Recorder	Spooled directly to hard-disk of control PC; unlimited file size or duration
Scope	Store in transient memory
Transient	Store in transient memory, single or A-B-A timebase

Ordering Information			
Model		**Unit Description**	**Order number**
BASIC 200k Digitizer		**200kS**, **128M** 8 Channel, 200 kS/s, Basic Card, 128 MB RAM (8 MS/ch)	1-GN810-2
BASIC 1M Digitizer		**1 MS**, **256M** 8 Channel, 1MS/s, Basic Card, 256 MB RAM (16 MS/ch)	1-GN811-2

Accessories		
Voltage Probes - Single Ended	**Unit Description**	**Order number**
100X, 2 kV	100x, Standard probe, 1.2 m cable. 400 MHz, 1000 V rms CAT II, 7-45 pF	1-G903-2
100X, 3 kV	100x, Standard probe, 2 m cable. 250 MHz, 2 kV AC, 3 kV DC, 4 kV impulse, CAT II, 10-50 pF	1-G904-2
1000X, 20 kV	1000x, HV probe, 3 m cable. 100 MHz, 20 kV, 10-50 pF Max Voltage 20 kV DC, 40 kV peak AC	1-G906-2

6.2.2 Basic 200K 1M XT ISO Digitizer

Capabilities Overview		
Component	**Value**	
Model	**BASIC 200K XT iso**	**BASIC 1M XT iso**
Sample rate	0.1 S/s to 200 kS/s	0.1S/s to 1 MS/s
Memory per card	64 MS (128 MB)	256 MS (512 MB)
Analog channels	8	8
ADC resolution	16 bit (0.0015 %)	
Input type	Unbalanced differential isolated (1)	

(1) An unbalanced differential input can be used to do differential measurements.

General Specifications

Analog Input Section		
Component	**Unit Description**	**Value**
Channels		8
Type		Unbalanced differential isolated (1)
Connectors	Fully insulated BNC	
Ranges	Plus variable gain in 1000 steps (0.1 %)	± 2.0 V, ± 4.0 V, ± 10.0 V, ± 20 V, ± 40 V, ± 100 V
Offset	1000 steps	0.1 %
Coupling	± 1 % full scale	DC, GND
Impedance		1 MΩ ± 1% // 55 pF ± 10%
Maximum Static Error		0.1 % of FS ± 40 µV
Noise	RMS	0.02 % of FS ± 30 µV
Analog Bandwidth	Overall bandwidth is always limited by digital filters	50 kHz @ -3 dB
CMRR		> 72 dB @ 100 Hz
Overload Protection		250 Vpeak
Number of slots	Including signal conditioners	1

Analog Input Section		
Component	**Unit Description**	**Value**
Isolation	Channel-to-chassis	250 V
	Channel-to-channel	250 V
	Non-destructive, to chassis (earth)	250 V

(1) An unbalanced differential input can be used to do differential, off ground, isolated measurements like a “real” differential input.

Analog to Digital Conversion			
Component		**Value**	
Model		**BASIC 200K XT ISO Digitizer**	**BASIC 1M XT ISO Digitizer**
Sample rate		0.1 S/s to 200 kS/s	0.1 S/s to 1 MS/s
ADC resolution		16 bit (0.0015 %)	
Timebase accuracy		50 ppm	
Filter		Bessel or FIR	Wideband (no filter), Bessel or FIR
Wideband bandwidth		n/a	500 kHz @ -3 db
Bessel filter specifics			
	Bandwidth	20 kHz	220 kHz
	Analog anti-aliasing	7-pole Bessel, optimal step response	
	Digital	6-pole Bessel style IIR, auto set to sample rate divided by: 10, 20, 40, 100 (user selection)	
FIR filter specifics			
	Maximum Bandwidth	50 kHz	370 kHz
	Analog Anti-Alias-Filter	7-pole Butterworth, extended frequency response	
	Analog Anti-Alias-Filter	12-pole FIR, auto set to sample-rate divided by: 4, 10, 20, 40 (user selection)	

Note *Bessel or FIR selection in the user interface always invoke a combination of an analog anti aliasing filter and a digital filter, as detailed in Analog to digital conversion.*

On-board Memory		
Component	**Value**	
Model	**BASIC 200K XT ISO Digitizer**	**BASIC 1M XT ISO Digitizer**
Per card	64 MS (128 MB)	64 MS (128 MB)
Per channel (with all 8 channels used)	8 MS (16 MB)	32 MS (64 MB)

Triggering			
Component		**Unit Description**	**Value**
Channel trigger		Fully independent, per channel	1
Pre- and post-trigger length			0 to full memory
Trigger rate		Up to 400 triggers per second, zero re-arm time	1 per 2.5 ms
Trigger total		Total number of triggers per recording	10,000
Resolution		For each level	16 bit (0.0015 %)
Hysteresis		Defines the trigger insensitivity	0.1 to 100 % of Full Scale
Cross channel triggering		Analog triggers of all channels	Logical OR
		Qualifiers of all channels	Logical AND
Analog trigger modes			
	Basic	Single level	Pos or neg crossing
	Dual Level	Two individual levels, OR-ed	One pos and one neg crossing
Analog qualifier modes			
	Basic	Arm the acquisition with a single level	Pos or neg crossing
	Dual (level)	Arm the acquisition with two individual levels, OR-ed	One pos and one neg crossing

Real-time Analysis	
Component	**Description**
StatStream ©	Each channel includes real-time extraction of Max, Min, Mean, Peak-to- Peak, and RMS values

Acquisition Modes	
Component	**Description**
Sweeps	Triggered acquisition to RAM without sample rate limitations; for single or repetitive transients or intermittent phenomena.
Continuous	Direct storage to PC or mainframe hard disc without file size limitations; triggered or un-triggered; for long duration recorder type applications with up to 1 MS/s rate per channel; (maximum aggregate rate pending from mainframe configuration and PC).
Dual	Combination of Sweeps and Continuous; recorder type streaming to hard disc with simultaneously triggered sweeps in RAM.
Slow fast sweep	A triggered acquisition in RAM which includes an acquisition phase with a higher sample rate, located at a point of interest.

Storage Modes	
Component	**Description**
Recorder	Spooled directly to hard-disk of control PC; unlimited file size or duration
Scope	Store in transient memory
Transient	Store in transient memory, single or A-B-A timebase

Ordering Information			
Model		**Unit Description**	**Order Number**
BASIC 200K XT ISO Digitizer		8 Channel, 200kS/s, Basic XT Card, 128 MB RAM (8 MS/ch), isolated, unbalanced differential, with extended input range	1-GN814-2
BASIC 1M XT ISO Digitizer		8 Channel, 1 MS/s, Basic XT Card, 512 MB RAM (32 MS/ch), isolated, unbalanced differential, with extended input range	1-GN813-2

Accessories		
Model	**Unit Description**	**Order number**
1kV Isolated Probe	Probe 100:1, isolated, 1.2 m cable, 1 kV max, 1 MHz bandwidth, 45-75 pF compensation range	1-G057-2
1kV DC Probe	1on10 Voltage divider; DC coupled, ± 1 kV, 49 inch cable; 19 inch rack mount	1-G041-2
1kV AC Probe	AC Voltage coupler, max DC input voltage ± 1kV DC; range depending on input module, ± 100V max, 49 inch cable; 19 inch rack mount	1-G042-2

Accessories (Racks)		
Model	**Unit Description**	**Order number**
DC Probe Rack	19 inch rack for 1 kV DC probes; 1 U height, holds a maximum of 16 DC probes	1-G019-2
AC Probe Rack	19 inch rack for 1 kV AC probes; 1 U height, holds a maximum of 16 AC probes	1-G020-2

6.2.3 Basic 1M ISO Digitizer

Capabilities Overview	
Component	**Value**
Sample rate	10 S/s to 1 MS/s
Type	Unbalanced differential (1)
Memory per card	256 MS (512 MB)
Analog channels	8
ADC resolution	16 bit (0.0015 %)
Channels	8
Input type	Unbalanced differential (1)

(1) An unbalanced differential input can be used to do differential measurements.

General Specifications

Analog Input Section		
Component	**Unit Description**	**Value**
Channels		8
Type		Unbalanced differential (1)
Connectors	Fully insulated BNC	
Ranges	Plus variable gain in 1000 steps (0.1 %)	± 1.0 V, ± 2.0 V, ± 5.0 V, ± 10 V, ± 20 V, ± 50 V
Offset	1000 steps	0.1 %
Coupling	DC, GND	± 1 % full scale
Impedance		2 x 1 MΩ// 65 pF ± 10 %
Maximum Static Error		0.1 % of FS ± 40 µV
Noise	RMS	0.02 % of FS ± 30 µV
Resolution	For each level	16 bit (= 0.0015 %)
CMRR		> 72 dB @ 100 Hz
Overload protection		250 Vpeak

Analog Input Section		
Component	**Unit Description**	**Value**
Number of slots	Including signal conditioners	1

(1) An unbalanced differential input can be used to do differential measurements.

Analog to Digital Conversion			
Component		**Unit Description**	**Value**
Sample Rate			0.1 S/s to 1 MS/s
ADC resolution			16 bit (0.0015 %)
Timebase accuracy			50 ppm
Filter			Bessel or Butterworth
Wideband bandwidth			500 kHz (-3 dB)
Bessel/butterworth filter specifics			
	Analog anti-aliasing	Bypass, Time, Frequency-domain optimized	
	Time Domain	7-pole Bessel, optimal step response	220 kHz
	Frequency Domain	7-pole Butterworth, extended frequency response	370 kHz
IIR or FIR filter specifics			
	Digital FIR	Off, Frequency domain optimized	
	Frequency	12-pole FIR at sample-rate divided by: 4, 10, 20, 40	
	Digital IIR	Off time domain optimized	
	Frequency	6-pole digital Bessel at sample-rate divided by: 10, 20, 40, 100	

On-board Memory		
Component	**Unit Description**	**Value**
Per card	Total size	256 MS (512 MB) shared by enabled channels
Per channel	Size (with all 8 channels used)	32 MS (64 MB)

Triggering			
Component		**Unit Description**	**Value**
Channel trigger		Fully independent, per channel	1
Pre- and post-trigger length			0 to full memory
Trigger rate		Up to 400 triggers per second, zero re-arm time	1 per 2.5 ms
Trigger total		Total number of triggers per recording	10,000
Resolution		For each level	16 bit (0.0015 %)
Hysteresis		Defines the trigger insensitivity	0.1 to 100 % of Full Scale
Cross channel triggering		Analog triggers of all channels	Logical OR
		Qualifiers of all channels	Logical AND
Analog trigger modes			
	Basic	Single level	Pos or neg crossing
	Dual Level	Two individual levels, OR-ed	One pos and one neg crossing
Analog qualifier modes			
	Basic	Arm the acquisition with a single level	Pos or neg crossing
	Dual (level)	Arm the acquisition with two individual levels, OR-ed	One pos and one neg crossing

Real-time Analysis	
Component	**Description**
StatStream ©	Each channel includes real-time extraction of Max, Min, Mean, Peak-to- Peak, and RMS values

Acquisition Modes	
Component	**Description**
Sweeps	Triggered acquisition to RAM without sample rate limitations; for single or repetitive transients or intermittent phenomena.
Continuous	Direct storage to PC or mainframe hard disc without file size limitations; triggered or un-triggered; for long duration recorder type applications with up to 1 MS/s rate per channel; (maximum aggregate rate pending from mainframe configuration and PC).

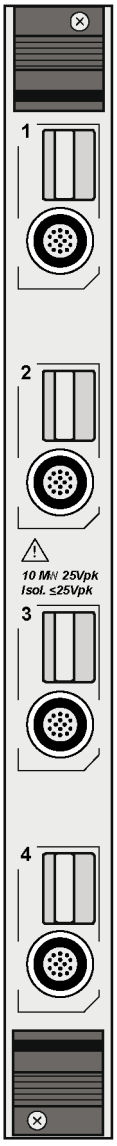
Acquisition Modes	
Component	**Description**
Dual	Combination of Sweeps and Continuous; recorder type streaming to hard disc with simultaneously triggered sweeps in RAM.
Slow fast sweep	A triggered acquisition in RAM which includes an acquisition phase with a higher sample rate, located at a point of interest.

Storage Modes	
Component	**Description**
Recorder	Spooled directly to hard-disk of control PC; unlimited file size or duration
Scope	Store in transient memory
Transient	Store in transient memory, single or A-B-A timebase

Ordering Information			
Model		**Unit Description**	**Order number**
Basic 1M ISO		8 Channel, 1MS/s, Basic Card, 512 MB RAM (32 MS/ch), isolated, unbalanced differential	1-GN812-2

Accessories		
Voltage probes - single ended	**Unit Description**	**Order number**
1X/10X 1.2 Meter	1X/10X Switchable probe, 1.2 m cable	1-G901-2
1X/10X 3 Meter	X/10X Switchable probe, 3 m cable	1-G902-2

6.3 Bridge input module



The GEN series bridge input modules are suitable for strain gages, strain-gage based force, pressure or torque transducers and piezo-resistive accelerometers. The inputs can also be used as a general purpose low voltage differential amplifier with AC and DC coupling. It provides bipolar DC excitation voltage or current, flexible software-switched completion options and a variety of calibration methods for any type of bridge configuration.

Front panel connectors are LEMO 2B type. Every channel is equipped with an independent high-gain amplifier, 7-pole Bessel and Butterworth anti-alias filters, 16-bit Analog-to-Digital converter operating at up to 1 MS/s, and digital filtering. All channels are sampled at full speed with no multiplexing and almost immeasurable crosstalk. A 200 kS/s model is available for medium speed acquisition requirements.

The bridge amplifiers support quarter, half and full bridge configurations from three to eleven wires. Each channel includes software-switched half-bridge completion resistors, two fixed shunt calibration resistor and one socket for an additional user-provided shunt resistor. A 350 Ω quarter-bridge completion resistor is supplied for each channel, plus one socket for an additional user supplied value. A unique and powerful ability allows the amplifier to individually measure each input and each excitation lead to quickly diagnose wiring problems. Each channel also features two set-points for trigger or alarm purposes plus hardware detection of open/shorted excitation leads and amplifier over-range.

6.3.1 Bridge 200K, 1M ISO Digitizer

Capabilities Overview		
Component	**Value**	
Model	**Bridge 200K ISO Digitizer**	**Bridge 1M ISO Digitizer**
Sample rate	0.1 S/s to 200 kS/s	0.1 S/s to 1 MS/s
Memory per card	64 MS (128 MB)	256 MS (512 MB)
Analog channels	4	
ADC resolution	16 bit (0.0015 %)	
Isolation	Yes	
Input type	Fully isolated bridge or fully isolated differential, software selectable	

General Specifications

Analog Input Section			
Component		**Unit Description**	**Value**
Channels			4
Type		Fully isolated bridge or fully isolated differential, software selectable	
Connectors		Mating connector:FGG2B316CLAD52	Lemo 16-pin
Ranges		Plus variable gain in 1000 steps (0.1 %)	± 2 mV, ± 5 mV, ± 10 mV, ± 20mV, ± 50 mV, ± 100 mV, ± 200 mV, ± 500 mV, ± 1 V, ± 2 V, ± 5 V, ± 10 V
Offset		1000 steps	0.1 %
Coupling		AC DC, GND	-3 dB @ 0.16 Hz
Impedance			2x 10 MΩ// 130 pF
Analog bandwidth		Overall bandwidth is always limited by digital filters	20 kHz (**Bridge 200k** only)
Maximum Static Error			
	Wideband		0.2 % of FS ± 120 µV
	Bessel/ Butterworth		0.1 % of FS ± 40 µV

Analog Input Section				
Component		**Unit Description**		**Value**
Noise		RMS		0.02 % of FS ± 30 µV
Resolution		For each level		16 bit (= 0.0015 %)
CMRR				> 72 dB @ 100 Hz
CM voltage		To amplifier ground		± 10 V
		To chassis (earth)		± 50 V
Overload protection				35 V
Number of slots		Including signal conditioners		1
Isolation				
	Channel - channel			100 V
	Channel - chassis			50 V
	Non-destructive	To chassis (earth)		100 V
Bridge amplifier				
	Gain	(± 10 V ÷ range)		5000, 2000, 1000, 500, 200, 100, 50, 20, 10, 5, 2, 1
	Fine gain			Variable gain in 1000 steps (0.1 %) within each range
	Balance voltage	Unbalance voltage compensation		± 250 mV max
Bridge support				
	Excitation			
	Voltage excitation	Off, in 1000 steps, up to 85 mA per channel		± 1.0 V to ± 7.5 V
	Current excitation	Off, 2 mA to 40 mA, 15 V compliance		
	Supported circuits	Two to ten wire included, driven guard		
	Completion resistors	Half bridge	Completion resistors	2x 100 kΩ (0.1%)
		Quarter bridge(1)		350 Ω

Analog Input Section			
Component		**Unit Description**	**Value**
	Shunt resistors	2 pre-installed calibration resistors(1) one user-defined, plus external, shunt to + or – excitation	20 kΩ, 100 kΩ
	Sense	2 separate sense wires or internal	

(1) These are metal-foil high-performance instrumentation resistors with a tolerance of 0.1% and a TCR of 0.6 ppm/°C

Analog to Digital Conversion			
Component		**Value**	
Model		**Bridge 200K XT ISO Digitizer**	**Bridge 1M XT ISO Digitizer**
Sample rate		0.1 S/s to 200 kS/s	0.1 S/s to 1 MS/s
ADC resolution		16 bit (0.0015 %)	16 bit (0.0015 %)
Timebase accuracy		50 ppm	
Wideband bandwidth		20 kHz	> 120 kHz at maximum Bandwidth gain (ranges ≤ ± 20 mV), 450 kHz at minimum gain
Bessel filter specifics			
	Analog anti-aliasing	Time, Frequency- domain optimized	Bypass, Time, Frequency-domain optimized
	Time Domain	7-pole Bessel, optimal step response	
		20 kHz	220 kHz
	Frequency Domain	7-pole Butterworth, extended frequency response	
		20 kHz	350 kHz
IIR or FIR filter specifics			
	Digital		
	Time Domain	6-pole Bessel style IIR, sample rate divided by: 10, 20, 40, 100	
	Frequency Domain	12-pole, FIR at sample-rate divided by: 4, 10, 20, 40	

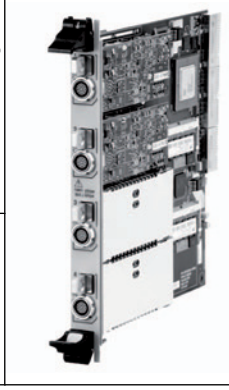
On-board Memory		
Component	**Value**	
Model	**Bridge 200K XT ISO Digitizer**	**Bridge 1M XT ISO Digitizer**
Per card (shared by enabled channels)	64 MS (128 MB)	256 MS (512 MB)
Per Channel	16 MS	64 MS

Triggering			
Component		**Unit Description**	**Value**
Channel trigger		Fully independent, per channel	1
Pre- and post-trigger length			0 to full memory
Trigger rate		Up to 400 triggers per second, zero re-arm time	1 per 2.5 ms
Trigger total		Total number of triggers per recording	10,000
Resolution		For each level	16 bit (0.0015 %)
Hysteresis		Defines the trigger insensitivity	0.1 to 100 % of Full Scale
Cross channel triggering		Analog triggers of all channels	Logical OR
		Qualifiers of all channels	Logical AND
Analog trigger modes			
	Basic	Single level	Pos or neg crossing
	Dual Level	Two individual levels, OR-ed	One pos and one neg crossing
Analog qualifier modes			
	Basic	Arm the acquisition with a single level	Pos or neg crossing
	Dual (level)	Arm the acquisition with two individual levels, OR-ed	One pos and one neg crossing

Real-time Analysis	
Component	**Description**
StatStream ©	Each channel includes real-time extraction of Max, Min, Mean, Peak-to- Peak, and RMS values

Acquisition Modes	
Component	**Description**
Sweeps	Triggered acquisition to RAM without sample rate limitations; for single or repetitive transients or intermittent phenomena.
Continuous	Direct storage to PC or mainframe hard disc without file size limitations; triggered or un-triggered; for long duration recorder type applications with up to 1 MS/s rate per channel; (maximum aggregate rate pending from mainframe configuration and PC).
Dual	Combination of Sweeps and Continuous; recorder type streaming to hard disc with simultaneously triggered sweeps in RAM.
Slow fast sweep	A triggered acquisition in RAM which includes an acquisition phase with a higher sample rate, located at a point of interest.

Storage Modes	
Component	**Description**
Recorder	Spooled directly to hard-disk of control PC; unlimited file size or duration
Scope	Store in transient memory
Transient	Store in transient memory, single or A-B-A timebase

Ordering Information			
Model		**Unit Description**	**Order number**
Bridge 200k ISO XT		**200kS**, **128M** 4 Channel, 200 kS/s Bridge Card, 128 MB RAM (16 MS/ch), isolated	1-GN410-2
Bridge 1M ISO XT		**1MS**, **512M** 4 Channel, 1 MS/s Bridge Card, 512 MB RAM (64 MS/ch), isolated	1-GN411-2

Accessories		
Model	**Unit Description**	**Order number**
G021	GEN DAQ Bridge completion/shunt cal resistor cards, 4 additional pieces (4 pieces included in both GN410 as well as GN411)	1-G021-2

6.3.2 Bridge amplifier configuration

Input diagrams and typical connection diagrams for the GEN series bridge amplifiers are shown on this and the following pages. For the maximum versatility, the amplifiers allow a wide range of configurations. At minimum three wires are necessary for a quarter- or half-bridge sensor and four wires for a full bridge. Optional remote sensing of excitation voltage is supported for precision transducer applications, which adds two wires. Remote shunt calibration is possible with the addition of two or three more wires. Finally, both an isolated common and a driven guard are provided for optional shielding.

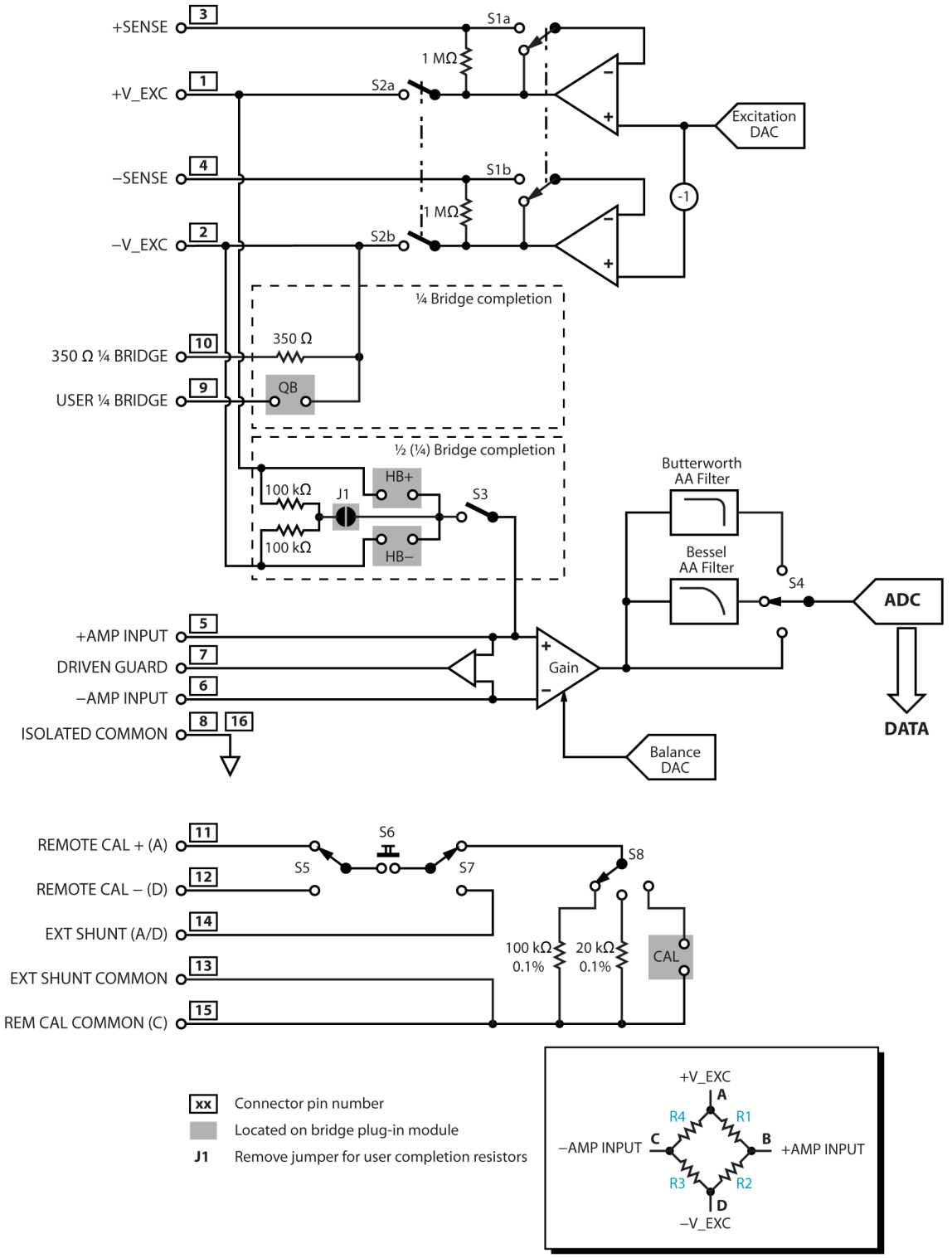


Figure 6.1: Bridge amplifier block diagram with pinning

6.3.3 Input connectors

The LEMO 2B316 connector pin-out is compatible with the Liberty data acquisition system. The mating male connector is LEMO P/N FGG2B316CLADxx, where xx is the desired cable collet size, or similar.

6.3.4 Bridge completion

Each bridge amplifier channel contains a pair of fixed 10 kΩ resistors for half-bridge completion that can be switched in under software control. The user can install two resistors on the removable bridge completion card for another value and/or precision half-bridge completion. If so, a soldered jumper must be removed for correct operation.

Additional pins on the LEMO connector provide a precision 350 Ω resistor plus an additional user-provided value for quarter-bridge completion. The user-provided value is located on removable bridge completion card. The completion sockets are designed for Vishay Micro Measurements S-Type resistors but can be used with other similar types. A diagram of the board layout on one of the following page shows the location of each resistor.

6.3.5 Shunt calibration

Each bridge amplifier channel contains 100 KΩ and 20 KΩ, 0.1% fixed precision resistors that can be switched in under software control. With a Gage Factor of 2.00, this resistor simulates the following values of deflection for various bridge configurations.

Table 6.3: Deflection for various bridge configurations

	100 KΩ			20 KΩ		
BRIDGE	**1000 Ω**	**350 Ω**	**120 Ω**	**1000 Ω**	**350 Ω**	**120 Ω**
mV/V	2.4888	0.873	0.299	12.20	4.337	1.495
µstr full bridge	1244	437	150	6098	2169	748
µstr $^1/_2$ bridge	2488	873	300	12195	4337	1496
µstr $^1/_4$ bridge	4975	1747	600	24390	8674	2991

A convenient plug-in module is provided for installation of one additional user-supplied shunt resistor on each channel. The diagram below shows the location of the user completion resistors. A fourth calibration resistor can be connected externally at the connector pins. Any of the four available shunt cal resistors can be switched in under software control to provide multi-point calibration and linearity verification.

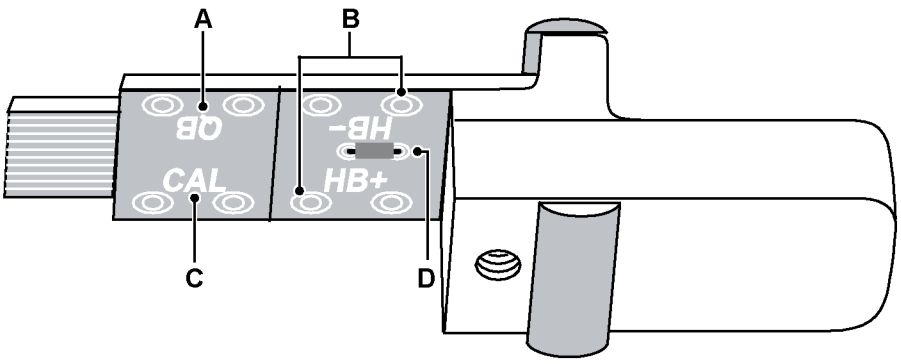


Figure 6.2: Shunt calibration completion plug-in module

A User Quarter-Bridge Completion

B User Half-Bridge Completion

C User Shunt Cal

D JUMPER! *Remove when installing Half-Bridge completion*

6.3.6 Shielding and driven guard

When long cable runs are required, the excitation leads and signal leads are generally separately twisted and shielded within the cable to minimize the cross-coupling that would otherwise occur.

The GEN series high-performance signal conditioners offers the “driven guard” system where the input shield is connected only to the drive pin of the conditioner and where the shield is driven to a potential equal to the common-mode voltage of the bridge. The driven shield or guard therefore minimizes the potential difference between the internal conductors and the shield, thereby reducing the mutual capacitance between them and the electrostatic coupling between the shield and the internal conductors. In all cases, the driven shield is terminated only at the driven guard conditioner terminal where the driven shield is surrounded by an outer shield that is terminated to ground preferably at the strain gage installation site as shown in Figure 6.3.

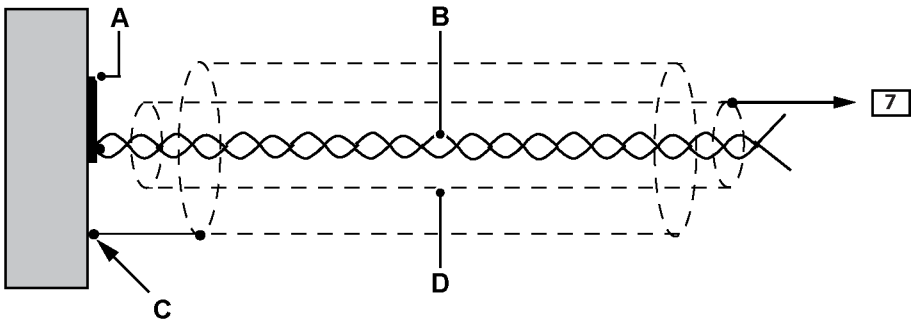


Figure 6.3: The driven guard approach to minimize induced noise

A Strain gages

B Signal conductors

C Outer shield
Terminated near strain gages - signal source

D Inner shield
Driven guard at +Vcm

6.3.7 Various bridge configurations

The diagram below shows possible bridge configurations.

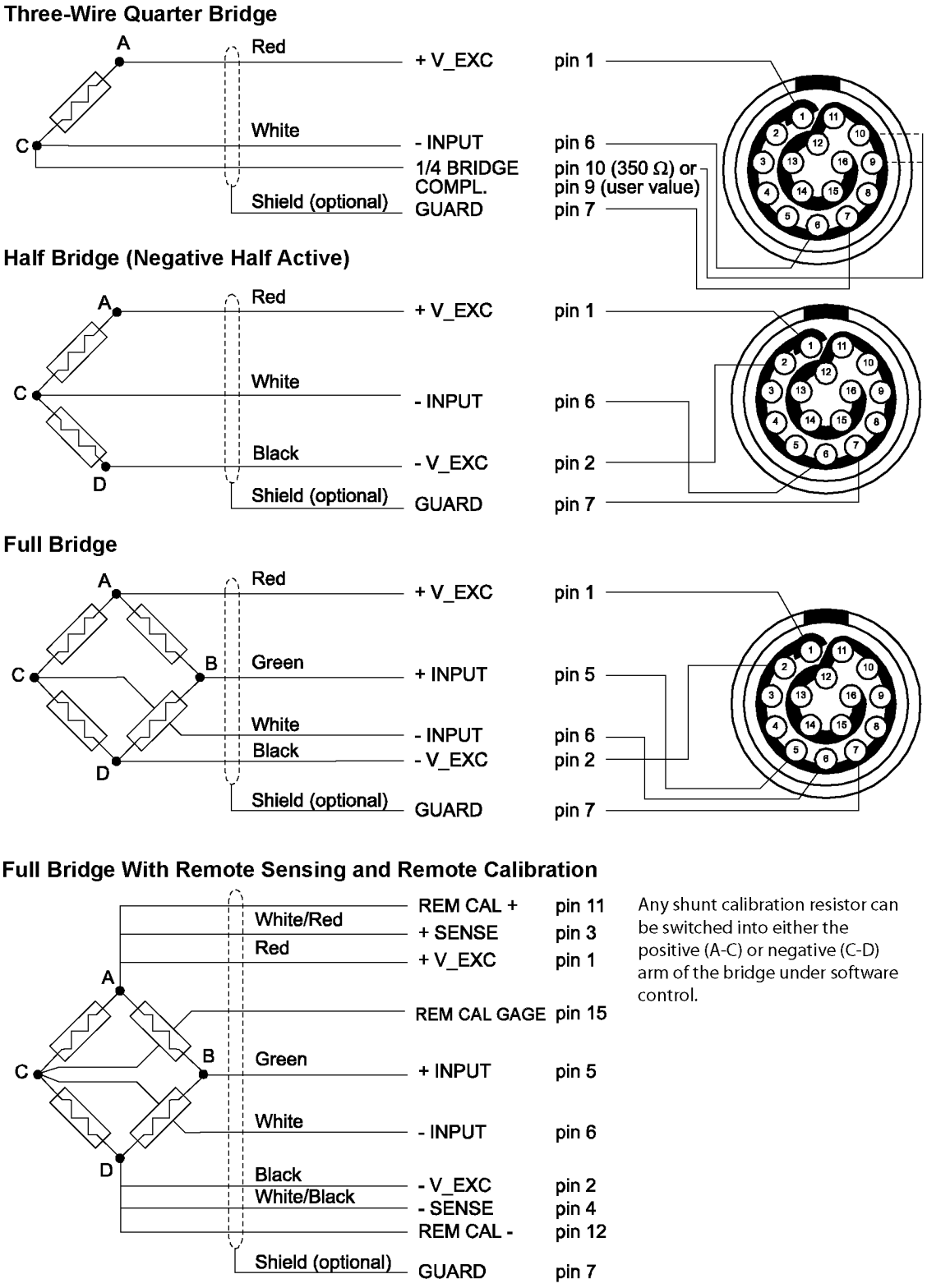


Figure 6.4: Full, half and quarter bridge configurations

6.3.8 Bridge connector reference card

Make copies of this page to record and document your test setups.

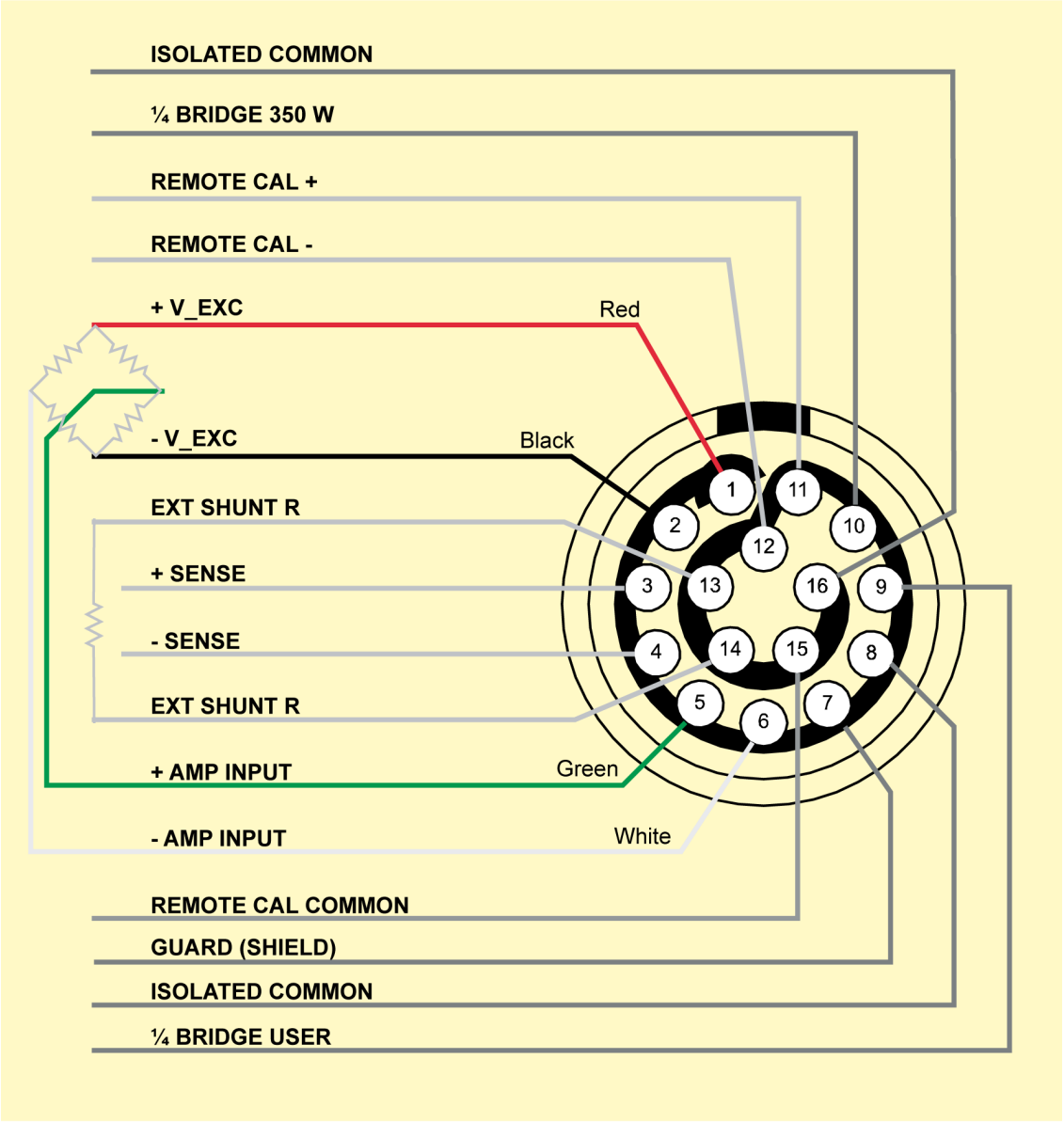


Figure 6.5: Reference card: LEMO FGG.2B.316 Connector, solder cup view of male connector

6.3.9 Configuring and using the bridge amplifier

This section describes the procedures required when configuring and using the bridge amplifier for both the hardware as well as the software (Perception).

In the Perception software a simplified block diagram is used as reference and complementary control.

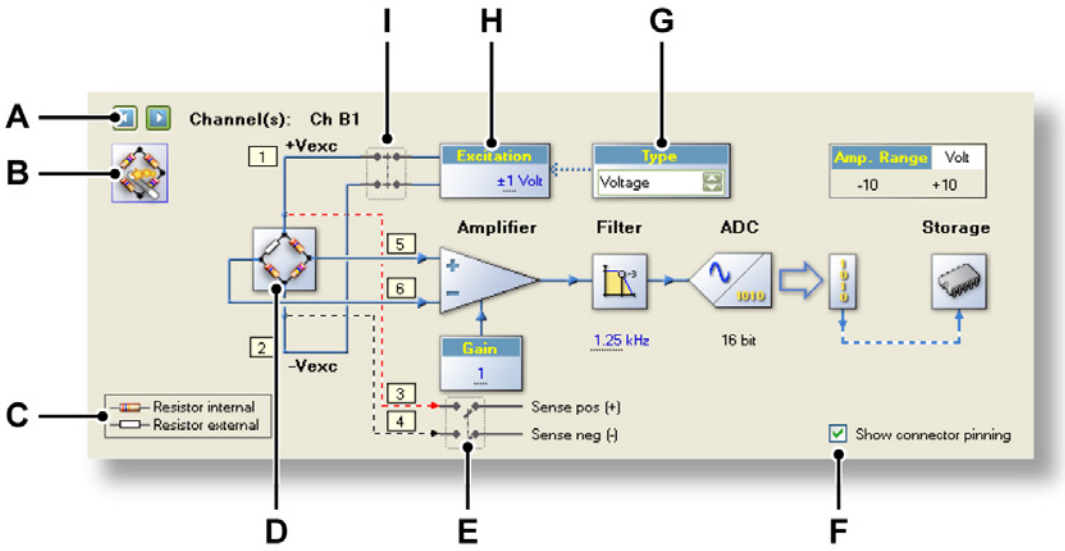


Figure 6.6: Perception bridge amplifier simplified block diagram

A Channel select

B Wizard icon: Click to select the Bridge wizard

C Legend: Internal = completion, external = bridge

D Bridge icon: click to toggle bridge completion

E Sense on/off (S1a and S1b in Figure 6.1 on page 115)

F Show connector pinning on/off

G Excitation type: voltage, voltage with sense, current

H Excitation value

I Excitation on/off (S2a and S2b in Figure 6.1 on page 115)

Bridge completion

The Wheatstone bridge used in most strain gage measurement circuits usually consists of (a) the gages for actively measuring the strains and (b) precision resistors for completing the circuit. In the GEN series bridge completion can be for full, half and quarter bridge configurations. Completion resistors can be internal (incorporated in the GEN series) or external (when required).

Bridge completion - full (4/4) bridge
A full bridge type sensor is a sensor that has all four bridge resistors on board: no completion is required.

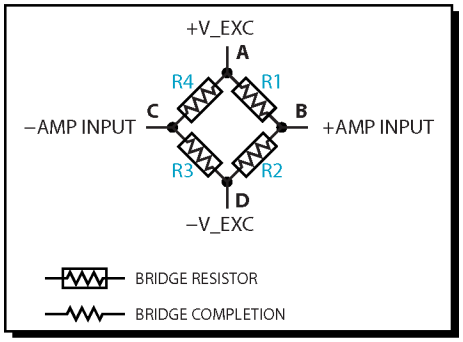


Figure 6.7: Full bridge layout

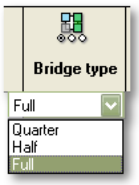
To connect such a bridge you need a minimum of four wires. Refer to Figure 6.4 on page 119 for connection details. When using a full bridge you need to inform the Perception software about this.

To select full bridge completion in Perception
To select full bridge completion proceed as follows:

1 In Perception go to the **Settings** sheet.
2 In the task pane select the **Bridge** in the **Input** section.
3 Select one or more channels.

4 Do one of the following:

- In the spreadsheet style matrix in the **Bridge type** column select the bridge type **Full**.



- In the simplified graphical diagram click on the bridge icon (**D** in Figure 6.6 on page 121) until you see the full bridge representation.

Bridge completion - half (1/2 or 2/4) bridge
A half bridge type sensor is a sensor that has two bridge resistors on board: completion is required.

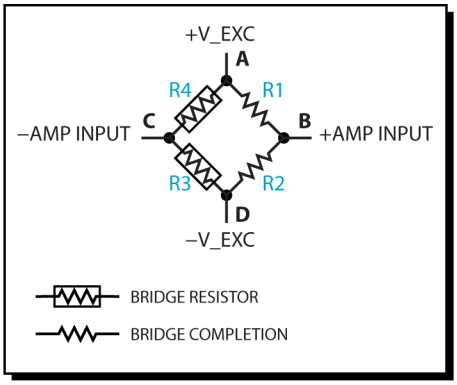


Figure 6.8: Half bridge layout

In this situation a sensor is used with two (out of four) resistors R4 and R3. These resistors are placed between A-C and C-D.

You now have to provide the two additional resistors R1 and R2. To do this there are two options:

1 Use the standard 100 kΩ resistors inside the acquisition module.
2 Provide two resistors.

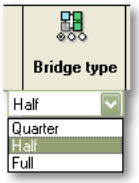
In situation (1) you do not need to do anything from a hardware point of view.

In situation (2) you will need to add the two resistors to the plug-in module on the locations marked HB+ and HB-. You will also need to remove the jumper J1. Refer to Figure 6.1 on page 115 for electrical/schematic details and to for mechanical/location details.

To connect such a bridge you need a minimum of three wires. Refer to Figure 6.4 on page 119 for connection details. When using a half bridge you need to inform the Perception software about this.

To select half bridge completion in Perception
To select half bridge completion in Perception proceed as follows:

1 In Perception go to the **Settings** sheet.
2 In the task pane select the **Bridge** in the **Input** section.
3 Select one or more channels.
4 Do one of the following:
- In the spreadsheet style matrix in the **Bridge type** column select the bridge type **Half**.



- In the simplified graphical diagram click on the bridge icon (**D** in Figure 6.6 on page 121) until you see the half bridge representation.

5 When you select half bridge completion, switch S3 in Figure 6.1 will be closed.

Bridge completion - quarter (1/4) bridge
A quarter bridge type sensor is a sensor that has a single bridge resistor on board: completion is required.

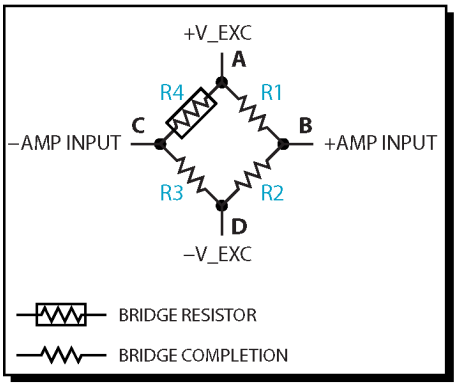


Figure 6.9: Quarter bridge layout

In this situation a sensor is used with only one resistor R4. This resistor is placed between A and C.

You now have to provide the three additional resistors R1, R2, and R3 for completion of the bridge. You do this by using the half-bridge completion as described in the previous section and adding an additional resistor R3 between C and D. To do this there are two options:

1 Use the standard 350 Ω resistor inside the acquisition module.
2 Provide a resistor.

In situation (1) you do not need to do anything from a hardware point of view.

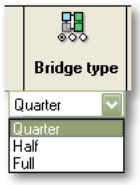
In situation (2) you will need to add the resistor on the plug-in module on the location marked QB. Refer to Figure 6.1 on page 115 for electrical/schematic details and to for mechanical/location details.

Additional wiring: you need to add wiring for the quarter bridge completion resistor. Depending on the selection you made, connect either pin 10 (350 Ohm) or pin 9 (user) to the bridge connection marked C in the diagram, or directly to pin 6 (-amp in) of the connector. Refer to Figure 6.4 on page 119 for connection details.

When using a quarter bridge you need to inform the Perception software about this.

To select quarter bridge completion in Perception
To select half bridge completion in Perception proceed as follows:

1 In Perception go to the **Settings** sheet.
2 In the task pane select the **Bridge** in the Input section.
3 Select one or more channels.
4 Do one of the following:
- In the spreadsheet style matrix in the **Bridge type** column select the bridge type **Quarter**.



- In the simplified graphical diagram click on the bridge icon (**D** in Figure 6.6 on page 121) until you see the quarter bridge representation.

5 When you select quarter bridge completion, switch S3 in Figure 6.1 on page 115 will be closed.

Excitation
The following options are provided for bridge excitation:

- You can switch excitation on and off.
- You can select between voltage and current excitation.
- You can use sense lines to make sure that the correct voltage is applied to the bridge even with longer lead wiring.

You make all these selections in the Perception application. However, when using sense lines you will need to do additional wiring:

- Add a connection from pin 3 (+sense) to the bridge connection marked A in Figure 6.1 on page 115.

- Add a connection from pin 4 (-sense) to the bridge connection marked D in Figure 6.1 on page 115.

Excitation on/off: Provision for separately switching off the bridge voltage while the remainder of the measuring circuit remains operational is an important and useful feature, particularly when measuring dynamic strains. Any output observed when the bridge voltage is switched off must be due to electrical noise, as the output cannot possibly be the result of resistance changes in the measuring circuit when a bridge voltage is not present. The ability to turn off the bridge power is therefore a useful diagnostic tool for establishing whether electrical noise is a problem.

Voltage and current excitation: For the balanced bridge it doesn't matter if the power supply is of the constant-voltage or constant-current variety. In both cases the output will be zero for the resistively balanced state. However, resistive balance circuits may be used with constant current excitation to obtain an initial zero balance of the instrument output when the bridge itself is unbalanced.

Sense lines: Remote sense or, more correctly, remote sensing of excitation voltage, is commonly recommended for use with precision, commercial transducers to prevent leadwire resistance changes (due to changes in either temperature or length) from affecting transducer span, or sensitivity.

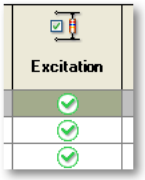
Leadwire attenuation presents a potentially significant error source in transducers utilizing a Wheatstone bridge circuit. The leadwires represent a parasitic resistance, and a portion of the excitation voltage intended for the bridge circuit is dropped in the leadwire system, reducing the voltage actually present at the transducer, and effectively reducing the transducer sensitivity.

In Perception
To make the required settings in the Perception software do the following:

1 In Perception go to the **Settings** sheet.
2 In the task pane select the **Bridge** in the **Input** section.
3 Select one or more channels.

4 To switch the excitation on or off do one of the following (this will open/close the switch marked S2a and S2b in Figure 6.1):

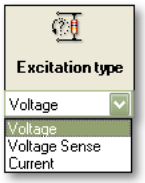
- In the spreadsheet style matrix double-click in the correct row(s) on the **Excitation** column.



- In the simplified graphical diagram click on the excitation switch (**I** in Figure 6.6 on page 121).

5 To select an excitation type do one of the following:

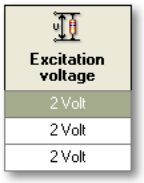
- In the spreadsheet style matrix in the **Excitation type** column make your selection



- In the simplified graphical diagram click the **Type** spinner (**G** in Figure 6.6 on page 121) until you see your selection.

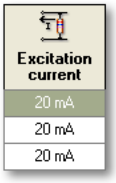
You can select between one of the following excitation type options:

- **Voltage:** Voltage excitation. When you select voltage excitation a voltage is applied between the bridge connection marked A (plus) and the bridge connection marked D (minus). To set the voltage level do one of the following:
  - In the spreadsheet style matrix in the **Excitation voltage** column enter the required voltage.



  - In the simplified graphical diagram use the **Excitation** box (**H** in Figure 6.6 on page 121) to enter a value.

- **Voltage Sense:** Voltage excitation with sense. When you select this option the sense lines are used: this will put the switch marked S1a and S1b in Figure 6.6 on page 121 into the sense position. Use the **Voltage** procedure to set the required voltage. You can also use the sense check boxes (marked **E** in Figure 6.6 on page 121) to toggle the sense lines.
- **Current:** Current excitation. Now a constant current is fed into the bridge. To set the current level do one of the following:
  - In the spreadsheet style matrix in the **Excitation current** column enter the required current.



  - In the simplified graphical diagram use the **Excitation** box (**H** in Figure 6.6 on page 121) to enter a value.

Shunt verification - setup

You can use a shunt resistor to verify a bridge: when you connect a shunt resistor in parallel with resistor R4 (A-C) or R3 (C-D) of the bridge this will produce an output signal simulating strain: a deflection. With known resistor and excitation values you can calculate the theoretical deflection. You can compare this with the measured deflection.

The following options are provided:

- Select the active bridge arm: A-C or C-D.
- Select between an internal or external shunt resistor.
- When **internal** select between:
  - **Factory installed:** 20 kΩ or 100 kΩ precision resistors.
  - **User installed:** you will need to add the resistor on the plug-in module on the location marked **CAL**. Refer to Figure 6.1 on page 115 for electrical/schematic details and to for mechanical/location details.

Additional wiring
When using remote calibration / shunt verification you will need to add the following wiring:

- Connect point A of bridge with pin 11 (Remote Cal +) of connector.
- Connect point D of bridge with pin 12 (Remote Cal -) of connector.
- Connect point D of bridge with pin 12 (Remote Cal -) of connector.
- In addition: when using an external shunt resistor connect this resistor between pin 14 (External Shunt A/D) and pin 13 (External Shunt Common) of connector.

For an example refer to Figure 6.4 "Full, half and quarter bridge configurations" on page 119.

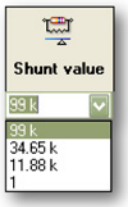
In Perception
To make the required settings in the Perception software do the following:

1 In Perception go to the **Settings** sheet.
2 In the task pane select the **Bridge** in the **Input** section.
3 Select one or more channels.

4 Select between internal or external shunt usage: in the **Internal shunt** column enable internal to use an **internal** shunt or clear the option to select an **external** resistor. This selection operates switch S7 in Figure 6.1.

Depending on the selection:

- When **internal** is chosen select the correct value in the **Shunt value** column:



or type the value of the CAL resistor. This selection operates switch S8 in Figure 6.1 on page 115.

- When **external** is chosen type the correct value of the external resistor in the **Shunt value** column.

5 Select the bridge arm to operate switch S5 in Figure 6.1 on page 115:

- In the sheet use the **Active gage** column to select between **Positive** (A-C) or **Negative** (C-D).

- In the simplified block diagram click on the **Remote calibration select** switch (**B** in Figure 6.6 on page 121) to switch between the two gages.

Shunt verification - procedure
Once you have correctly set up all wiring and resistors you can do an actual shunt verification.

Shunt verification preparation
To do a shunt verification in Perception make the following preparations:

1 In Perception go to the **Settings** sheet.
2 In the task pane select the **Bridge** in the **Input** section.
3 Select one or more channels.
4 Switch **Excitation ON**.
5 Select an **Excitation voltage.**
6 In the task pane select **Shunt Verification** in the **Sensors** section.
7 Select one or more channels.
8 Select between internal or external shunt usage: in the **Internal shunt** column enable internal to use an **internal** shunt or clear the option to select an **external** resistor. Make the appropriate value setting as described earlier.You can also click on the switch in the diagram (**G** in Figure 6.10).
9 Select the bridge arm: use the **Active gage** column to select between **Positive** (A-C) or **Negative** (C-D).You can also click on the switch in the diagram (**I** in Figure 6.10).

The actual shunt verification is done using the shunt verification dialog.

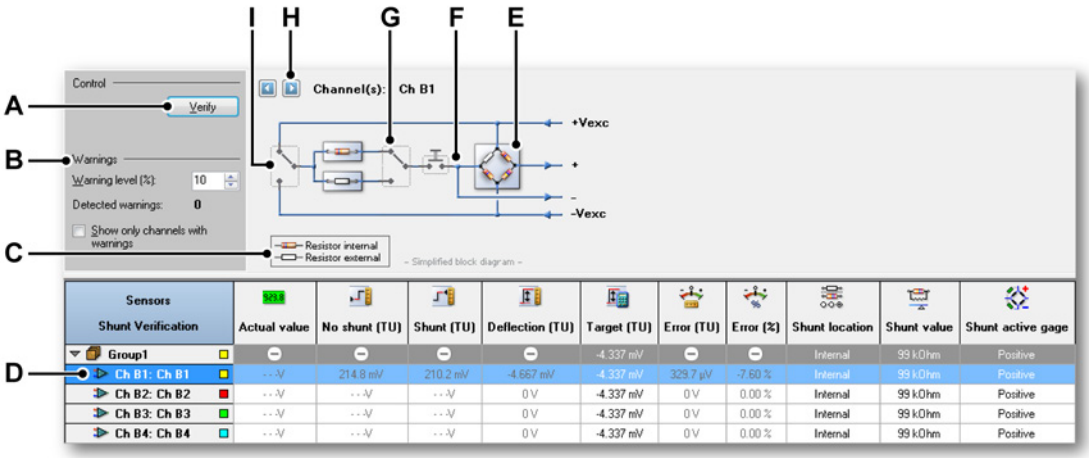


Figure 6.10: Shunt Verification dialog

A Verify command

B Warning group with warning level

C Legend: internal or external resistor used

D Channel with verification results

E Bridge icon: click to toggle bridge completion

F Graphical verify command

G Switch between internal and external resistor

H Channel select

I Switch between positive and negative arm of bridge (active gage)

Shunt verification
To do the actual shunt verification:

1. In Perception go to the **Settings** sheet.
2. In the task pane select **Shunt Verification** in the **Sensors** section.
3. Select one or more channels.
4. Enter a value for the **Warning level** (B – percentage).
5. Enter a value as target in the Target column: the target value is the result of the bridge value, excitation value and shunt value. Tables exist for commonly used values. As an example refer to Table in the “Shunt calibration” section on page 116. In Figure 6.10 the value is used that corresponds to a 350 Ω bridge, 20 kΩ shunt - therefore a 4.337 mV deflection per volt excitation - and 1 volt excitation.
6. Click **Verify**. This will actually close S6 in Figure 6.1 for a short period of time to measure the deflection.

Bridge balance
The bridge circuit is only in balance (has no output when the bridge voltage is applied) provided that R1 / R2 = R4 / R3. Taking into account the various resistance tolerances on the strain gage(s), resistors and leadwires, an initial unbalance is invariably present. Adjustment of initial balance so that at zero strain there is zero output is achieved by bridge balancing.

While resistive-balance circuits are widely used in strain gage instrumentation, the GEN series uses an alternative electronic method of balancing the output to zero involving measuring the output of the bridge and injecting an equal and opposite voltage. This method permits rapid automatic balancing in multi-channel systems and eliminates the bridge loading errors that are possible in the resistive system when making measurements with precision strain gage transducers.

HINT/TIP

When doing a bridge balance, the GEN series acquisition card measures the input value at the connector of the acquisition card. This means it cannot “see” if a bridge is actually connected or not. When no voltage is present this can be since the bridge is balanced or that no bridge is connected.

Bridge balancing in Perception is done through the Bridge Balance dialog.

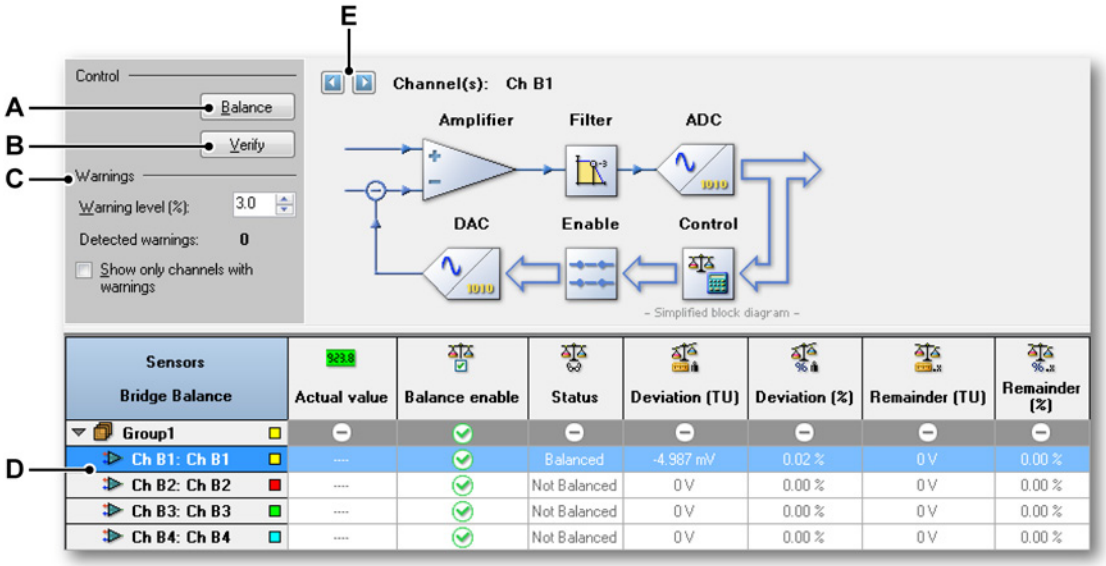


Figure 6.11: Bridge Balance dialog

A Balance command

B Verify command

C Warning group with warning level

D Channel with balance results

E Channel select

To balance a bridge

To balance a bridge in Perception do the following:

1. In Perception go to the **Settings** sheet.
2. In task pane select **Bridge Balance** in the **Sensors** section.
3. Use the **Balance Enable** column to enable/disable the balancing of channels.
4. Enter a value for the **Warning level** (C – percentage): an offset that cannot be compensated.
5. Select one or more channels.
6. Click the **Balance** command and wait for the results.

6.4 Universal amplifier input module

This unique, high-end, input module with ultra-fast amplifier serves a variety of needs; from differential and/or isolated measurements to IEPE-based vibration or shunt-based current measurements.

The universal amplifier input module has four input channels, each sampling at 200 kS/s or 1 MS/s maximum with 16 bit resolution. The bandwidth is 500 kHz and a selection of time or frequency domain optimized filters is available to eliminate noise if needed. The voltage range for a channel can be set from ±10 mV to ±100 V, making the board adaptable to nearly every application.True optical isolation allows for measurements with up to 250 V RMS common mode voltage.

The on-board differential input amplifiers eliminate noise picked up in the device under test or the measurement leads. Each amplifier typically offers a high CMRR of 80dB. By switching to "IEPE mode", the amplifiers supports any type of constant current supplied vibration and acceleration sensors. In "Current mode", the built-in shunt can be used to measure up to 1 ampère in a safe, isolated and fused manner, without the need of external shunt resistors.

6.4.1 Universal 200K 1M ISO Digitizer

Capabilities Overview		
Component	**Value**	
Model	**Universal 200 iso CARD**	**Universal 1M iso CARD**
Sample rate (maximum)	200 kS/s	1 MS/s
Memory per card	64 MS (128 MB)	256 MS (512 MB)
Analog channels	4	

Capabilities Overview	
Component	**Value**
ADC resolution	16 bit (0.0015 %)
Isolation	Yes
Input type	Differential; software selectable: voltage, current or IEPE; differential or single ended isolated

General Specifications

Analog Input Section			
Component		**Unit Description**	**Value**
Channels			4
Type		Differential; software selectable: voltage, current or IEPE; differential or single ended isolated	
Connectors		4 x 2 isolated BNC	
Ranges		13, programmable:	
	Course	± 10 mV to ± 100 V in 1, 2, 5 steps	± 10 mV, ± 100 mV, ± 200 mV, ± 400 mV, ± 1 V, ± 2 V, ± 4 V, ± 10 V, ± 20mV, ± 40 V, ± 100 V, ± 200 V
	Fine	Variable gain in 1000 steps (0.1 %) of the selected range within each course range	
Offset (zero position)		Software selectable in 1000 steps (0.1 %) of selected Full Scale, with a maximum of ± 50 % in the ± 100 V range	0.1% 50 % Maximum
Coupling		AC DC, GND	(-3 dB @ 1.6 Hz)
Impedance			2 x 1 MΩ// 100 pF
Maximum Static Error (2)			± 0.1 % of Full Scale ± 100 µV
Gain Error (2)			± 0.1 % of Full Scale ± 100 µV
Offset Error (2)			± 0.02 % full scale ± 100 µV

Analog Input Section			
Component		**Unit Description**	**Value**
Noise (RMS)			0.02 % + 116 µV
Analog Bandwidth			20 kHz (-3 dB)
CMRR		Typical @ 80 Hz for all ranges	< -80 dB
CM voltage		Ranges < ± 2 V Ranges > = ± 20 V Other ranges; all referred to amplifier ground	< 10 Vpeak < 250 Vpeak < 100 Vpeak
Measurement Overrange			5 % above/below Full Scale
Recovery time		to 0.03 % after a 200 % Full Scale overload	≤ 10 µs
Isolation			
	Channel – channel	Peak isolation	250 Vpeak
	Channel – chassis	Peak isolation	250 Vpeak
	Maximum input voltage	Ranges < ± 2 V Ranges ≥ ± 2 V	± 100 V ± 250 V
	Maximum common mode voltage	250 Volt peak with isolated common floating	+ 250 Vpeak
IEPE amplifier support (1)			
	Ranges	7 ranges from in 1, 2, 5 steps	± 0.2 V to ± 20 V
	Excitation current	Software selectable in 1 mA steps	1 to 15 mA
	Excitation accuracy	Nominal	24 V
	Coupling time constant		1 s
Current Shunt Support			
	Ranges	5 ranges in 1, 2, 5 steps	± 50 mA to ± 1 A
	Accuracy (2)		≤ 0.2 % of FS } ± 300 µA
	Measurement Shunt		0.2 Ω ± 1 %
	Maximum Current		1 A

Analog Input Section			
Component		**Unit Description**	**Value**
	Overload Protection	Resettable fuse, 0.1 Ω ± 20 %	1.6 A

(1) IEPE refers to internally amplified sensors - low impedance, piezoelectric force, acceleration and pressure type sensors with built-in integrated circuits.

(2) Errors are listed for amplifier with filter (IIR or FIR)

Analog to Digital Conversion			
Component		**Value**	
Model		**Universal 200 ISO CARD**	**Universal 1M ISO CARD**
Sample rate		200 kS/s to 0.1 S/s	1 MS/s to 0.1 S/s
ADC resolution		16 bit (0.0015 %)	
Timebase accuracy		50 ppm	
Bessel or Butterworth filter specifics			
	Analog anti-aliasing	Time- or Frequency domain optimized	Bypass, Time, Frequency-domain optimized
	Time Domain	7-pole Bessel, optimal step response	
		20 kHz	< ± 0.2 V: 185 kHz (-3 dB) ≥ ± 0.2 V: 220 kHz (-3 dB)
	Frequency Domain	7-pole Butterworth, extended frequency response	
		20 kHz	< ± 0.2 V: 300 kHz (-3 dB) ≥ ± 0.2 V: 350 kHz (-3 dB)
IIR or FIR filter specifics			
	Digital	IIR or FIR	
	Frequency domain	12-pole FIR at sample rate divided by: 4, 10, 20, 40	12-pole FIR at sample-rate divided by: 4, 10, 20, 40
	Time domain	6-pole Bessel style IIR, sample rate divided by: 10, 20, 40, 100	6-pole Bessel style IIR, sample rate divided by: 10, 20, 40, 100

On-board Memory		
Component	**Value**	
Model	**Universal 200 ISO CARD**	**Universal 1M ISOCARD**
Per card (Mega Samples)	64 MS shared by enabled channels	256 MS shared by enabled channels
Per channel	16 MS per channel	64 MS

Triggering		
Component	**Unit Description**	**Value**
Channel trigger	Fully independent, per channel	1
Pre- and post-trigger length		0 to full memory
Trigger rate	Up to 400 triggers per second, zero re-arm time	1 per 2.5 ms
Trigger total	Total number of triggers per recording	10,000
Resolution	For each level	16 bit (0.0015 %)
Hysteresis	Defines the trigger insensitivity	0.1 to 100 % of Full Scale
Cross channel triggering	Analog triggers of all channels	Logical OR
	Qualifiers of all channels	Logical AND

Real-time Analysis	
Component	**Description**
StatStream ©	Each channel includes real-time extraction of Max, Min, Mean, Peak-to- Peak, and RMS values

Acquisition Modes	
Component	**Description**
Sweeps	Triggered acquisition to RAM without sample rate limitations; for single or repetitive transients or intermittent phenomena.
Continuous	Direct storage to PC or mainframe hard disc without file size limitations; triggered or un-triggered; for long duration recorder type applications with up to 1 MS/s rate per channel; (maximum aggregate rate pending from mainframe configuration and PC).
Dual	Combination of Sweeps and Continuous; recorder type streaming to hard disc with simultaneously triggered sweeps in RAM.

Acquisition Modes	
Component	**Description**
Slow fast sweep	A triggered acquisition in RAM which includes an acquisition phase with a higher sample rate, located at a point of interest.

Storage Modes	
Component	**Description**
Recorder	Spooled directly to hard-disk of control PC; unlimited file size or duration
Scope	Store in transient memory
Transient	Store in transient memory, single or A-B-A timebase

Ordering Information			
Model		**Unit Description**	**Order number**
Uni 200kS, 128M		4 Channel, 200 kS/s Universal Card, 128 MB RAM (16 MS/ch)	1-GN440-2
Uni 1MS, 512M		4 Channel, 1 MS/s Universal Card, 512 MB RAM (64 MS/ch) isolated	1-GN441-2

6.4.2 A note on probes

Due to the high capacitive load of the input of the universal amplifier, special care must be taken when selecting a probe for measurements. This section describes some related issues.

A probe makes a physical and electrical connection between a test point or signal source and the instrument. Depending on your measurement needs, this connection can be made with something as simple as a length of wire or with something as sophisticated as an active differential probe.

For the purpose of this document we only describe attenuating probes within two categories: 1X Probes and 10X Probes.

6.4.3 1X Probes

1X probes, also known as 1:1 (one-to-one) probes, simply connect the input of the instrument to the circuit being measured. They are designed for minimum loss and easy connection, but otherwise they are equivalent to using a cable to connect the instrument. Figure 6.12 shows the circuit diagram for an instrument input connected to a circuit under test. The circuit under test is modeled as a voltage source with a series resistor. The 1X probe (or cable) will introduce a significant amount of capacitance that appears in parallel with the input of the instrument. A 1X probe may have around 40 to 60 pF of capacitance.

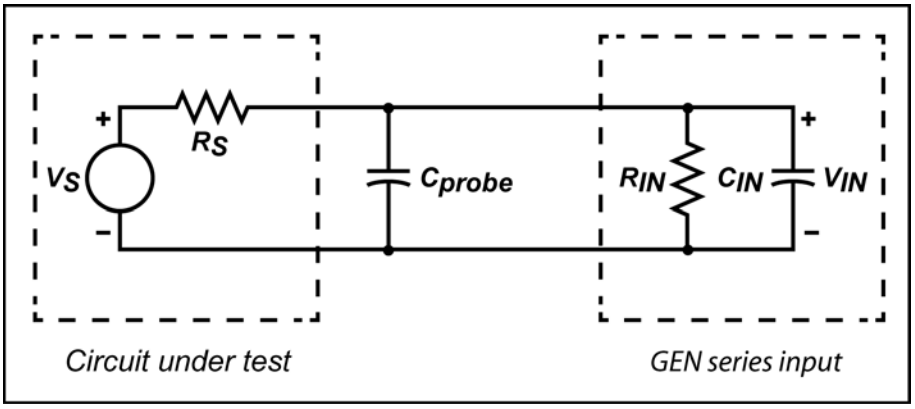


Figure 6.12: Input connected using a 1X probe

The impedance of the circuit and the input impedance of the instrument together produce a low-pass filter. For very low frequencies, the capacitor acts as an open circuit and has little or no effect on the measurement. For high frequencies, the capacitor's impedance becomes significant and loads down the voltage seen by the instrument. Figure 6.13 shows this effect in the frequency domain. If the input is a sine wave, the amplitude tends to decrease with increasing frequency and the phase is shifted.

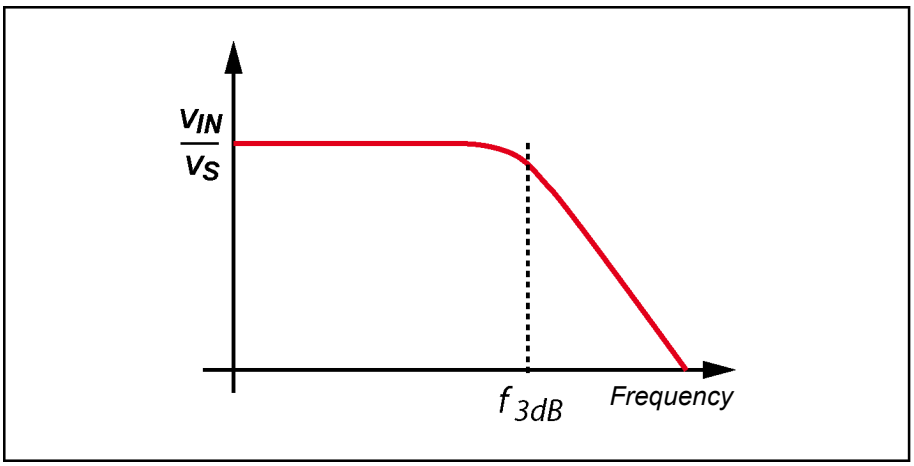


Figure 6.13: Frequency response with 1X probe

Example: assume a voltage source with a 1 MΩ resistance and a 1X probe with 50 pF capacitance (a 1X probe by itself has no resistance). The GEN series universal amplifier input has a 1 MΩ resistance and a 100 pF capacitance.

This yields a – 3dB point at:

(EQ1)

$$f(\text{-}3db) = \frac{1}{2\pi(R_s \| R_{IN})\ (C_{IN}+C_{probe})}$$

= 1 / (6.28 x 500 E+3 x 150 E-12) ≈ 2 kHz

The loading due to the input impedance of the instrument and the probe capacitance is twofold: resistive loading and capacitive loading.

The resistive loading actually reduces the voltage delivered to the instrument:

(EQ2)

$$V_{IN} = V_S\left(\frac{R_{IN}}{R_{IN}+R_S}\right)$$

The effect of the capacitive loading is more complex and results in an exponential response in the voltage:

(EQ3)

$$V_{IN}(t) = V_{MAX}\left[1 - e^{-t/(R_S C_{in\ +\ probe})}\right]$$

6.4.4 10X probes

10X probes (also called 10:1 probes, divider probes, or attenuating probes) have a resistor and capacitor (in parallel) inserted into the probe. Figure 6-14 shows the circuit for the 10X probe connected to a high-impedance input of an instrument.

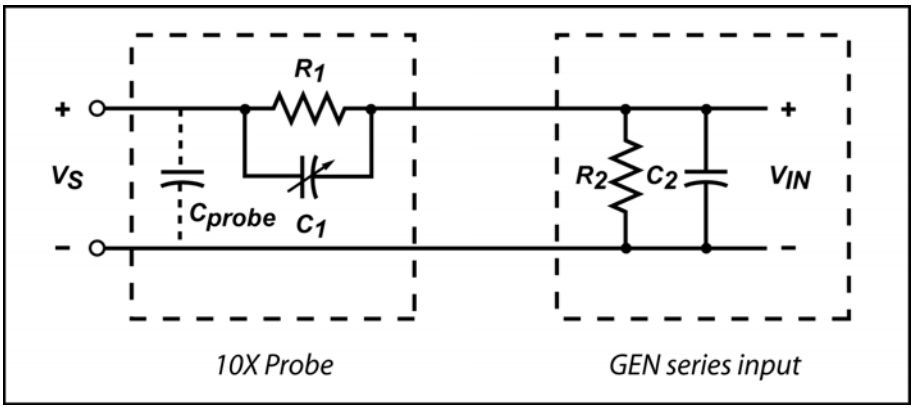


Figure 6.14: Input connected using a 10X probe

If R1C1 = R2C2, then this circuit has the result that the effect of both capacitors exactly cancel. The capacitor is usually made adjustable and can be tweaked for a near perfect match. Under these conditions, the relationship of VS to VIN is:

(EQ 4)

$$V_{IN} = V_S\left(\frac{R_2}{R_1 + R_2}\right)$$

R2 is the input resistance of the instrument's high input impedance (1 MΩ) and R1 = 9R2. From the previous equation, this results in:

(EQ 5)

$$V_{IN} = \left(\frac{1}{10}\right)V_S$$

So the final result is a probe / instrument input combination that has a much wider bandwidth than the 1X probe, due to the effective cancellation of the two capacitors. However, the instrument now sees only one-tenth of the original voltage (hence the name 10X probe). Also notice that the circuit being measured sees a load impedance of R1 + R2 = 10 MΩ, which is much higher than with the 1X probe.

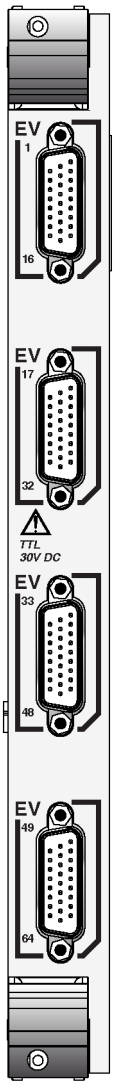
IMPORTANT

For a correct compensation it is necessary that both impedances have the same value, i.e. R1C1 = R2C2. In practice, this condition may not be met exactly but can be approximated. The probe's compensation capacitor is usually made adjustable somewhere between 10 pF and 50 pF to compensate for the instrument's input capacitance. Since the GEN series Universal Amplifier has a 100 pF capacitance there is no way to compensate correctly with standard probes. Therefore the probe capacitance must be adapted to this situation. Various probe manufacturers offer the possibility to purchase probes with other compensation ranges on request.

6.4.5 Probes and differential measurements

Connecting the differential amplifier or probe to the signal source is generally a great source of error. To maintain the input match, both paths should be as identical as possible. Any cabling should be of the same length for both inputs. If individual probes are used for each signal line, they should be the same model and cable length. When measuring low-frequency signals with large common-mode voltages, avoid the use of attenuating probes. At high gains, they simply cannot be used as it's impossible to precisely balance their attenuation. When attenuation is needed for high-voltage or high-frequency applications, special passive probes designed specifically for differential applications should be used. These probes have provisions for precisely trimming DC attenuation and AC compensation. To get the best performance, a set of probes should be dedicated to each specific amplifier and calibrated with that amplifier using the procedure included with the probes.

6.5 Binary marker module



The GEN series binary marker input board is a dedicated binary input option for the GEN series. It enables to record up to 64 binary input channels (marker channels) with up to 1 MS/s per channel. In addition 9 binary input channels can be assigned under software control to provide 3 channels of counter/timer functionality.

The binary channels can be recorded and reviewed in Perception like analog channels and enable a large number of binary status signals to be recorded together with the analog input channels.

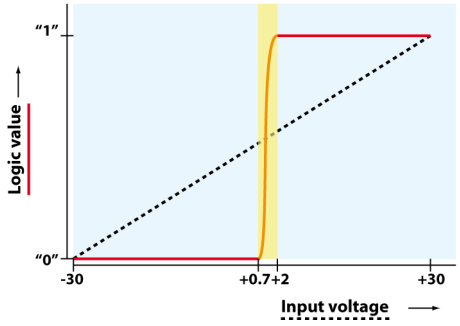
The counter/timer functionality includes:

- 64-bit general purpose up/down counter
- Frequency/RPM counter
- Quadrature/position measurements

The counter/timer functionality uses up to 3 event bits per channel. These event bits also keep their original functionality. You can, for example, use a quadrature encoder and at the same time look at the quadrature signals separately.

6.5.1 Binary Marker 1M

Analog to Digital Conversion		
Component	**Unit Description**	**Value**
Sample rate	Maximum	1 MS/s
Type	TTL, active low with pull-up resistor to enable activation by relays or short-circuit to ground	

Digital Input Section				
Component		**Unit Description**		**Value**
Connectors		Four connectors with 16 events per connector		4 x 26-pin SubD
	Type	TTL		KF66-A26P-N
Pull-up				25.5 kΩ @ 5 Volt
Voltage range		TTL compatible, maximum		30 V
Voltage levels		Logic threshold voltage level '0' Logic threshold voltage level '1'		- 30 V to + 0.7 V 30 V Maximum
		 **Figure 6.15:** Logic threshold voltage levels		
Protection				± 30 V continuous
Reset modes				
	External	Logical		"1" or "0"
	Modes	Manual (software control), On Start of Acquisition, Use an External Trigger Once, Use an External Trigger Always. The reset functionality of the counter/ timer is under software control and can be set for each channel separately.		
Conditional functionality				
	Modes	Trigger, Qualifier, Alarm		
	Trigger			
		Modes	Off, rising edge active, falling edge active	
		Combination	Each event trigger is OR-ed with all other trigger sources	
	Qualifier			
		Modes	Off, active high/low	

Digital Input Section				
Component		**Unit Description**		**Value**
		Combination	Each event qualifier is AND-ed with all other qualifier sources	
	Alarm			
		Modes	Off, active high, active low	
Functionality				
	General			
		Number of Channels		3
		Pins per channel		3
		Function	• Clock • Direction • Reset	
		Sample size		64 Bits (8 Bytes)
		Operation modes	• Counter • Quadrature counter • RPM • Frequency	
	Counter mode			
		Count size		64 bits
		Maximum frequency		10 MHz
		Direction	External	Up/down
		Reset to “0”	• Manual by user • At start of recording • By reset pin once after start of recording • By reset pin always	
	Quadrature mode			
		Count size		64 bits
		Maximum frequency		10 MHz
		Direction	External	Up/down
		Reset to “0”	• Manual by user • At start of recording • By reset pin once after start of recording • By reset pin always	
	RPM mode			
		Count size		64 bits
		Maximum frequency		10 MHz
		Direction	External	Up/down

Digital Input Section				
Component		**Unit Description**		**Value**
		Gate time	User selectable in 1, 2, 5 steps	1 ms to 10 sec
		Inaccuracy	Gate time	10 ns
		Measure-ment	Counts and period	
		Pulse per rotation	User selectable	
		RPM	Counts/(period * pulse per rotation)	
	Frequency mode			
		Count size		64 bits
		Maximum frequency		10 MHz
		Direction	External	Up/down
		Gate time	User selectable in 1, 2, 5 steps	1 ms to 10 sec
		Inaccuracy	Gate time	10 ns
		Measure-ment	Counts and period	
		Frequency	Counts/period	

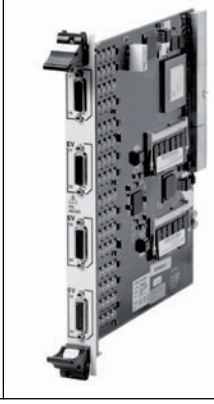
On-board Memory			
Component		**Unit Description**	**Value**
Per card		The memory splits between marker inputs and counter/timers channels.	512 MB
Per channel			
	Usable memory is:	Markers enabled only (1-64)	64 MS
		Markers plus 1 counter Ch enabled	32 MS
		Markers plus 2 counter Ch enabled	20 MS
		Markers plus 3 counter Ch enabled	16 MS

Acquisition Modes	
Component	**Description**
Sweeps	Triggered acquisition to RAM without sample rate limitations; for single or repetitive transients or intermittent phenomena.

Acquisition Modes	
Component	**Description**
Continuous	Direct storage to PC or mainframe hard disc without file size limitations; triggered or un-triggered; for long duration recorder type applications with up to 1 MS/s rate per channel; (maximum aggregate rate pending from mainframe configuration and PC).
Dual	Combination of Sweeps and Continuous; recorder type streaming to hard disc with simultaneously triggered sweeps in RAM.
Slow fast sweep	A triggered acquisition in RAM which includes an acquisition phase with a higher sample rate, located at a point of interest.

Storage Modes	
Component	**Description**
Recorder	Spooled directly to hard-disk of control PC; unlimited file size or duration
Scope	Store in transient memory
Transient	Store in transient memory, single or A-B-A timebase

Miscellaneous		
Component	**Unit Description**	**Value**
Output power	Typical @ 20 °C (ambient PCB)	5 V @ 0.5 A
	Typical @ 60 °C (ambient PCB)	5 V @ 0.35 A

Ordering Information			
Model		**Unit Description**	**Order number**
GN6470		**1 MS TTL Card** 64 binary channels, 1 MS/s Digital Input Card, 512 MB RAM, TTL Level, 4 SubD input connectors.	1-GN6470-2

6.5.2 Connector pinning

The binary marker modules come with four 26-pin connectors. The following diagram and table provide the pinning information.

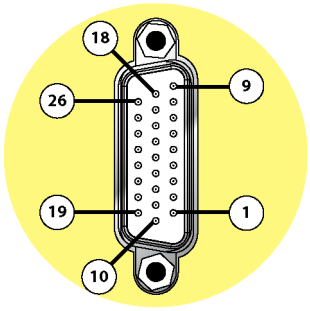


Figure 6.16: Binary marker module connector pinning

Table 6.4: Event bit (marker) connector pinning

PIN #	EV1-16	EV17-32	EV33-48	EV49-64
1	Event Bit 16	Event Bit 32	Event Bit 48	Event Bit 64
2	Event Bit 15	Event Bit 31	Event Bit 47	Event Bit 63 *
3	Event Bit 14	Event Bit 30	Event Bit 46	Event Bit 62 *
4	Event Bit 13	Event Bit 29	Event Bit 45	Event Bit 61 *
5	Event Bit 12	Event Bit 28	Event Bit 44	Event Bit 60
6	Event Bit 11	Event Bit 27	Event Bit 43	Event Bit 59 *
7	Event Bit 10	Event Bit 26	Event Bit 42	Event Bit 58 *
8	Event Bit 9	Event Bit 25	Event Bit 41	Event Bit 57 *
9	Event Bit 8	Event Bit 24	Event Bit 40	Event Bit 56
10	Event Bit 7	Event Bit 23	Event Bit 39	Event Bit 55 *
11	Event Bit 6	Event Bit 22	Event Bit 38	Event Bit 54 *
12	Event Bit 5	Event Bit 21	Event Bit 37	Event Bit 53 *
13	Event Bit 4	Event Bit 20	Event Bit 36	Event Bit 52
14	Event Bit 3	Event Bit 19	Event Bit 35	Event Bit 51
15	Event Bit 2	Event Bit 18	Event Bit 34	Event Bit 50
16	Event Bit 1	Event Bit 17	Event Bit 33	Event Bit 49
17	Ground	Ground	Ground	Ground
18	Ground	Ground	Ground	Ground
19	Ground	Ground	Ground	Ground
20	Ground	Ground	Ground	Ground
21	Ground	Ground	Ground	Ground

PIN #	EV1-16	EV17-32	EV33-48	EV49-64
22	Ground	Ground	Ground	Ground
23	Ground	Ground	Ground	Ground
24	Ground	Ground	Ground	Ground
25	+ 5 V	+ 5 V	+ 5 V	+ 5 V
26	+ 5 V	+ 5 V	+ 5 V	+ 5 V

(*) = Event input combined with counter/timer channel function

6.5.3 Counter mode

When in counter mode Event Bit 53 through 63 are used to provide the counter functionality. These bits are located on the bottom connector as follows:

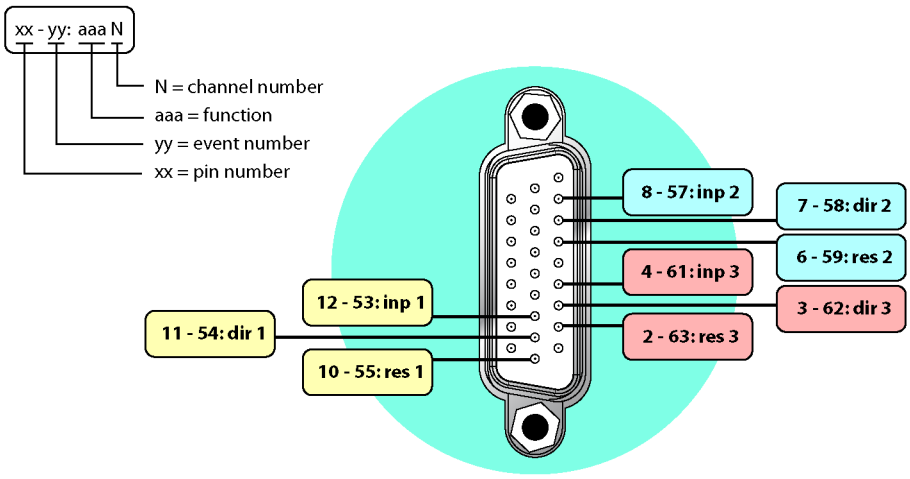


Figure 6.17: Counter pinning layout

Table 6.5: Counter bit connector pinning

PIN #	EVENT	COUNTER	FUNCTION
12	Event Bit 53	1	Counter input
11	Event Bit 54	1	Direction: increment / decrement
10	Event Bit 55	1	Reset
8	Event Bit 57	2	Counter input
7	Event Bit 58	2	Direction: increment / decrement
6	Event Bit 59	2	Reset
4	Event Bit 61	3	Counter input
3	Event Bit 62	3	Direction: increment / decrement
2	Event Bit 63	3	Reset

In the Perception software the event bits are combined within one channel and labeled as CH1_1 through CH1_64. The counter/timer channels are referred to as CH2 through CH4.

Counter input The counter input is the actual signal input. The counter value will be modified on each rising edge of this signal. The maximum input rate is 10 Mhz.

Direction The direction signal determines if the counter will be incremented (direction = “0”), or decremented (direction = “1”) on each rising edge of the counter input.

Reset The reset signal will reset the counter to zero. The reset enabling as well as the active level is determined under software control.

The actual mode of the counter/timer channel is selected in the Perception software.

6.5.4 Frequency (RPM) mode

When in frequency mode Event Bit 53 through 63 are used to provide the frequency measurement functionality. These bits are located on the bottom connector as follows:

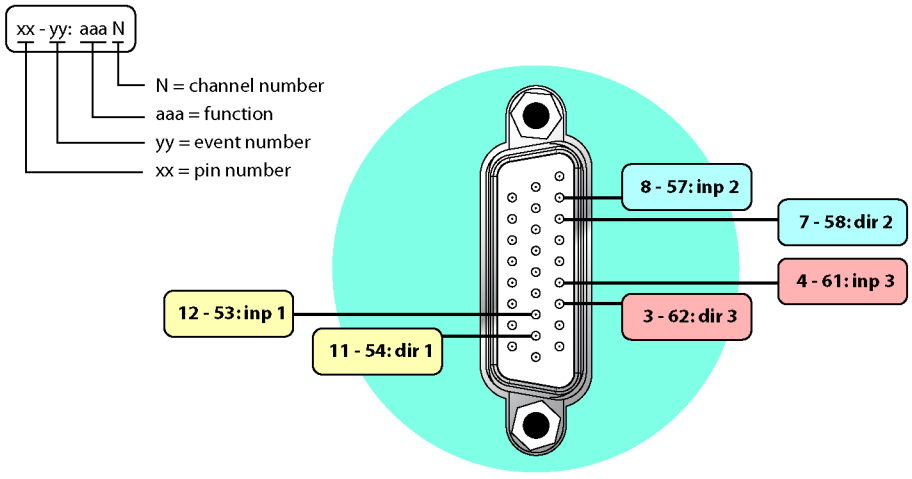


Figure 6.18: Frequency measurement pinning layout

Table 6.6: Counter bit connector pinning

PIN #	EVENT	FREQ. CH.	FUNCTION
12	Event Bit 53	1	Counter input
11	Event Bit 54	1	Direction: increment / decrement
10	Event Bit 55	–	Not used
8	Event Bit 57	2	Counter input
7	Event Bit 58	2	Direction: increment / decrement
6	Event Bit 59	–	Not used
4	Event Bit 61	3	Counter input
3	Event Bit 62	3	Direction: increment / decrement
2	Event Bit 63	–	Not used

In the Perception software the event bits are combined within one channel and labeled as CH1_1 through CH1_64. The counter/timer channels are referred to as CH2 through CH4.

For frequency measurements, the counter/timer channels use an additional gate-clock to create a time-interval (gate-time) in which pulses are counted. The gate-time determines the possible resolution of the measurement. The minimum gate-time is 1 µs, the maximum gate-time is 10 s.

Counter input The counter input is the actual signal input. The counter will be incremented on each rising edge of this signal. The maximum input frequency is 10 MHz.

Direction The direction signal determines if the counter will be incremented (direction = “0”), or decremented (direction = “1”) on each rising edge of the counter input.

The actual mode of the counter/timer channel is selected in the Perception software. In Perception the RPM is derived from the measured frequency.

6.5.5 Quadrature (position) mode

When in quadrature mode Event Bit 53 through 63 are used to provide the position measurement capability by measuring the signals as provided by quadrature encoders. These bits are located on the bottom connector as follows:

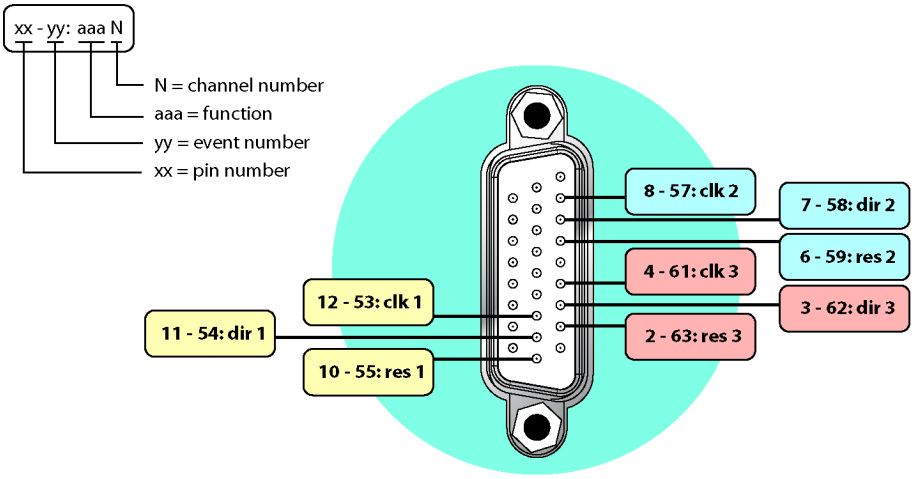


Figure 6.19: Quadrature measurement pinning layout

Table 6.7: Quadrature measurement bit connector pinning

PIN #	EVENT	QUAD. CH.	FUNCTION
12	Event Bit 53	1	Clock input (A)
11	Event Bit 54	1	Direction input (B)
10	Event Bit 55	1	Reset
8	Event Bit 57	2	Clock input (A)
7	Event Bit 58	2	Direction input (B)
6	Event Bit 59	2	Reset
4	Event Bit 61	3	Clock input (A)
3	Event Bit 62	3	Direction input (B)
2	Event Bit 63	3	Reset

In the Perception software the event bits are combined within one channel and labeled as CH1_1 through CH1_64. The counter/timer channels are referred to as CH2 through CH4.

Clock input (A) The clock input is the actual signal input. The counter will be incremented on each rising edge of this signal if the direction input is low (“0”). The counter will be decremented on each rising edge of this signal if the direction input is high (“1”).

Direction input (B) The direction signal determines if the counter will be incremented (direction = “0”), or decremented (direction = “1”) on each rising edge of the counter input.

Reset The reset signal will reset the counter to zero. The reset enabling as well as the active level is determined under software control.

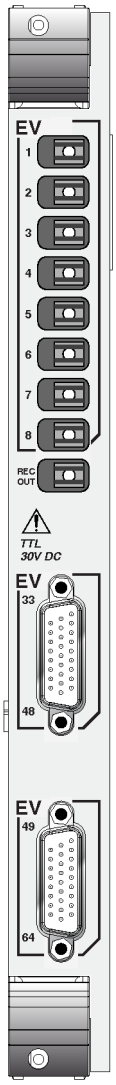
The actual mode of the counter/timer channel is selected in the Perception software.

The most common type of incremental encoder uses two output channels (A and B) to sense position. Using two code tracks with sectors positioned 90 degrees out of phase, the two output channels of the quadrature encoder indicate both position and direction of rotation. If A leads B, for example, the disk is rotating in a clockwise direction. If B leads A, then the disk is rotating in a counter-clockwise direction.

By monitoring both the number of pulses and the relative phase of signals A and B, you can track both the position and direction of rotation.

Some quadrature encoders also include a third output channel, called a zero or index or reference signal, which supplies a single pulse per revolution. This single pulse is used for precise determination of a reference position.

6.6 Binary marker HV module



The GEN series binary marker input HV board allows you to acquire 32 digital event signals (markers) as well as 8 digital event signals that are optically isolated. Although general purpose, this board is specifically suited for the medium/high voltage market. A fiber-optic isolated output is provided to present an REC-signal that can be used to drive an external instrument. The fiber-optic inputs and the fiber-optic REC output allow for a tight integration with the BE3200 high-definition test sequencer.

In addition 9 binary input channels can be assigned under software control to provide 3 channels of counter/timer functionality.

The counter/timer functionality includes:

- 64-bit general purpose up/down counter
- Frequency/RPM counter
- Quadrature/position measurements

The counter/timer functionality uses up to 3 event bits per channel. These event bits also keep their original functionality. You can, for example, use a quadrature encoder and at the same time look at the quadrature signals separately.

6.6.1 Binary Marker HV

General Specifications

Analog Input Section		
Component	**Unit Description**	**Value**
Channels	Fiber-optic isolated marker (event) inputs	8
	Non-isolated marker(event) inputs	32
	Fiber-optic isolated ARM output	1
Type	TTL, active low with pull-up resistor to enable activation by relays or short-circuit to ground	
Connectors	Two connectors with 16 events per connector	2 x 26-pin SubD
Fiber-optic connectors		8 in + 1 out

Analog to Digital Conversion		
Component	**Unit Description**	**Value**
Sample rate	Maximum	1 MS/s

Digital Input Section		
Component	**Unit Description**	**Value**
Connectors	Fiber-optic connectors	8 in + 1 out
Type		KF66-A26P-N
Pull-up		25.5 kΩ @ 5 Volt
Voltage range	TTL compatible, maximum	30 V
Voltage levels	Logic threshold voltage level '0'	- 30 V to + 0.7 V
	Logic threshold voltage level '1'	+ 2 V to + 30 V

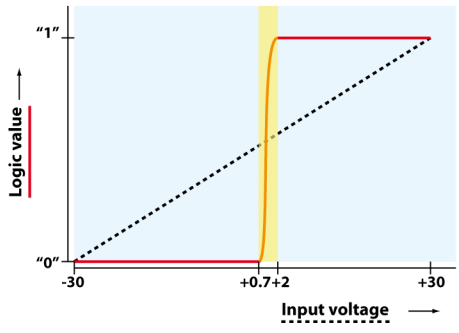
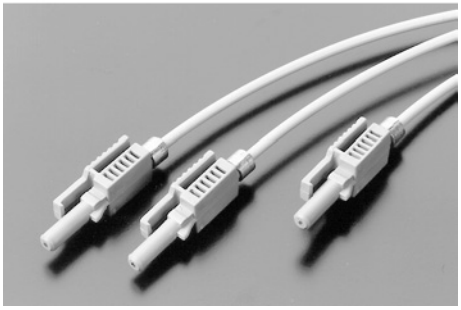


Figure 6.20: Logic threshold voltage levels

Digital Input Section				
Component		**Unit Description**		**Value**
Protection		Continuous		± 30 V
Fiber-optic cable (recommended)				
	Type	Plastic, single step index, HP HFBR-RXXYYY series		HP HFBR-RXXYYY
	Diameter	Core and cladding		1.00 mm
	Attenuation			0.22 dB/m
	Delay	Propagation delay constant		5.0 ns/m
Fiber-optic I/O				
	Sockets	(660 nm LED)	Input:	HP HFBR-2523
			Output:	HP HFBR-1523
	Connectors	Simplex latching connector		HP HFBR-4503
	Output drive	Distance		60 m to 100 m
	Compatibility	Fully compatible with HBM BE3200 Test Sequencer		BE3200
		 **Figure 6.21:** Fiber-optic cables		
Conditional functionality				
	Modes	Trigger, Qualifier, Alarm		
	Trigger			
		Modes Off, rising edge active, falling edge active		
		Combination Logic condition: Event trigger OR any other trigger source		
	Qualifier			
		Modes	Off, active high/low	
		Combination	Logic condition: Event qualifier AND any other qualifier sources	

Digital Input Section				
Component		**Unit Description**		**Value**
	Alarm			
		Modes	Off, active high, active low	
	Output functionality			
		ARM (status)	Active when continuous recording active, or named in triggered sweep mode	
Functionality				
	General			
		Number of Channels		3
		Pins per channel		3
		Function	• Clock • Direction • Reset	
		Sample size		64 Bits (8 Bytes)
		Operation modes	• Counter • Quadrature counter • RPM • Frequency	
	Counter mode			
		Count size		64 bits
		Maximum frequency		10 MHz
		Direction	External	Up/down
		Reset to “0”	• Manual by user • At start of recording • By reset pin once after start of recording • By reset pin always	
	Quadrature mode			
		Count size		64 bits
		Maximum frequency		10 MHz
		Direction	External	Up/down
		Reset to “0”	• Manual by user • At start of recording • By reset pin once after start of recording • By reset pin always	
	RPM mode			
		Count size		64 bits
		Maximum frequency		10 MHz

Digital Input Section				
Component		**Unit Description**		**Value**
		Direction	External	Up/down
		Gate time	User selectable in 1, 2, 5 steps	1 ms to 10 sec
		Inaccuracy	Gate time	10 ns
		Measure-ment	Counts and period	
		Pulse per rotation	User selectable	
		RPM	Counts/(period * pulse per rotation)	
	Frequency mode			
		Count size		64 bits
		Maximum frequency		10 MHz
		Direction	External	Up/down
		Gate time	User selectable in 1, 2, 5 steps	1 ms to 10 sec
		Inaccuracy	Gate time	10 ns
		Measure-ment	Counts and period	
		Frequency	Counts/period	

On-board Memory			
Component		**Unit Description**	**Value**
Per card		The memory splits between marker inputs and counter/timers channels.	512 MB
Per channel			
	Usable memory is:	Markers enabled only (1-64)	64 MS
		Markers plus 1 counter Ch enabled	32 MS
		Markers plus 2 counter Ch enabled	20 MS
		Markers plus 3 counter Ch enabled	16 MS

Acquisition Modes	
Component	**Description**
Sweeps	Triggered acquisition to RAM without sample rate limitations; for single or repetitive transients or intermittent phenomena.

Acquisition Modes	
Component	**Description**
Continuous	Direct storage to PC or mainframe hard disc without file size limitations; triggered or un-triggered; for long duration recorder type applications with up to 1 MS/s rate per channel; (maximum aggregate rate pending from mainframe configuration and PC).
Dual	Combination of Sweeps and Continuous; recorder type streaming to hard disc with simultaneously triggered sweeps in RAM.
Slow fast sweep	A triggered acquisition in RAM which includes an acquisition phase with a higher sample rate, located at a point of interest.

Storage Modes	
Component	**Description**
Recorder	Spooled directly to hard-disk of control PC; unlimited file size or duration
Scope	Store in transient memory
Transient	Store in transient memory, single or A-B-A timebase

Miscellaneous		
Component	**Unit Description**	**Value**
Output power	Typical @ 20 °C (ambient PCB)	5 V @ 0.5 A
	Typical @ 60 °C (ambient PCB)	5 V @ 0.35 A

Ordering Information			
Model		**Unit Description**	**Order number**
Binary Marker HV 1 MS TTL/Fiber Optical Card		32+8 binary channels, 1 MS/s Digital Input Card, 512 MB RAM, TTL level/light, SubD/ LWL input connectors	1-GN4070-2

6.6.2 Connector pinning

The binary marker HV modules come with nine (9) fiber-optic connectors and two (2) 26-pin connectors. The lowest fiber-optic connector provides the REC status output. The fiber-optic input connectors provide the marker (event) channels 1 through 8. The non-isolated marker inputs provide the marker (event) channels labeled 33 through 64.

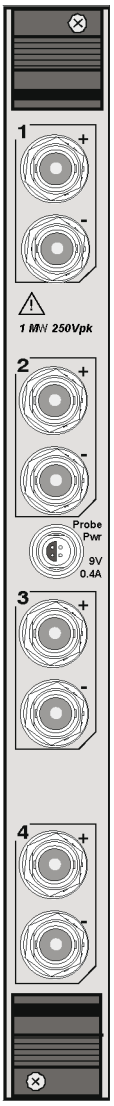
For a description of the non-isolated channels see "Connector pinning" on page 150. Refer to the channels 33 through 64 only.

6.6.3 Counter/timer modes

The counter/timer modes are exactly the same as for the standard binary marker input board. For a description of these modes, see "Counter mode" on page 151, "Frequency (RPM) mode" on page 152 and see "Quadrature (position) mode" on page 153.

6.7 High Speed Digitizers - differential inputs

For ultra fast signals, the **25 MS/s** and **100 MS/s** high speed digitizer boards are equipped with four channels sampling at incredible high speed. With selectable anti-aliasing filtering and 14-bit (100 MS/s) or 15-bit resolution (25 MS/s), these inputs turn the GEN series into an extremely fast transient recorder. Enhanced resolution mode increases input resolution for both models to 16-bit at lower speeds. The inputs feature a fully differential amplifier offering good common mode rejection and enabling off ground measurements.



6.7.1 Fast differential 25, 100M Digitizers

Capabilities Overview		
Component	**Value**	
Model	**Fast Differential Digitizers 25 MS/s**	**Fast Differential Digitizers 100 MS/s**
Sample rate	1 kS/s to 25 MS/s	1 kS/s to 100 MS/s
Memory per card	64 MS (128 MB)	900 MS (1800 MB)
Analog channels	4	
ADC resolution	15-bit (0.003 %)	14-bit (0.006 %)
Input type	Differential	

General Specifications

Analog Input Section			
Component	**Unit Description**	**Value**	
Model		**Fast Differential Digitizers 25 MS/s**	**Fast Differential Digitizers 100 MS/s**
Channels	Per slot	4	
Type		Differential	
Connectors	Metal BNC, outer shell grounded	2	
Ranges	Full Scale in 1, 2, 5 steps	± 10 mV, ± 100 mV, ± 200 mV, ± 400 mV, ± 1 V, ± 2 V, ± 4 V, ± 10 V, ± 20mV, ± 40 V, ± 100 V, ± 200 V	
Offset (zero position)	Equal to span; maximum 50 % in the ± 100 V range	Automatic	
Offset error		0.1 % FS ± 0.1 mV	
Coupling	AC DC, GND	-3 dB @ 1.6 Hz ± 10 %	
Impedance	for ranges ≤ ± 1 V	2 x 1 MΩ//21 pF	
	for ranges > ± 1 V	2 x 1 MΩ//25 pF	
Maximum Static Error		0.1 % FS ± 0.1 mV	
Gain Error		± 0.1 % ± 0.1 mV	
Noise	RMS	0.05 % FS ± 0.1 mV	
Analog bandwidth (1)		10 MHz @ -3 dB	25 MHz@ -3 dB
Rise time (1)	@ maximum BW	35 ns	14 ns
CMRR	For ranges ≤ ± 1 V	≥ 70 dB	
	For ranges > ± 1 V	≥ 60 dB	
CM voltage	For ranges ≤ ± 1 V	4 Vpeak	
	For ranges ≥ ± 20 V	250 Vpeak	
	For all other ranges	40 Vpeak	
Overload protection	Peak protected	250 Vpeak	

(1) Analog bandwidth specifications. Values will differ when the digital IIR filter is used at the same time.

Analog to Digital Conversion			
Component		**Value**	
Model		**Fast Differential Digitizers 25 MS/s**	**Fast Differential Digitizers 100 MS/s**
Sample rate		25 MS/s	100 MS/s
Sampling		Single ADC per channel, synchronous between all channels	
ADC resolution		15-bit (0.003 %)	14-bit (0.006 %)
	Enhanced resolution for sample rates ≤ 10 MS/s	16-bit	
Bessel filter specifics			
	Analog anti-aliasing	6th order Bessel low pass, 10 MHz @ -3dB	
Bessel or IIR specifics			
	Digital	6th order Bessel (IIR) Low pass, in 12 steps 5 MHz to 50 kHz	

On-board Memory		
Component	**Value**	
Model	**Fast Differential Digitizers 25 MS/s**	**Fast Differential Digitizers 100 MS/s**
Per card	25 MS/s	100 MS/s
Per channel (with all 4 channels used)	16 MS (64 MS)	100 MS (400 MS)

Triggering		
Component	**Unit Description**	**Value**
Channel trigger	Fully independent, per channel	1
Pre- and post-trigger length		0 to full memory
Trigger rate	Up to 400 triggers per second, zero re-arm time	1 per 2.5 ms
Trigger total	Total number of triggers per recording	10,000
Resolution	For each level	16 bit (0.0015 %)
Hysteresis	Defines the trigger insensitivity	0.1 to 100 % of Full Scale

Triggering			
Component		**Unit Description**	**Value**
Cross channel triggering		Analog triggers of all channels	Logical OR
		Qualifiers of all channels	Logical AND
Analog trigger modes			
	Basic	Single level	Pos or neg crossing
	Dual Level	Two individual levels, OR-ed	One pos and one neg crossing
Analog qualifier modes			
	Basic	Arm the acquisition with a single level	Pos or neg crossing
	Dual (level)	Arm the acquisition with two individual levels, OR-ed	One pos and one neg crossing

Real-time Analysis	
Component	**Description**
StatStream ©	Each channel includes real-time extraction of Max, Min, Mean, Peak-to- Peak, and RMS values

Acquisition Modes	
Component	**Description**
Sweeps	Triggered acquisition to on-board Random Access Memory (RAM) without sample rate limitations.
Continuous	Direct storage to PC or mainframe hard disk without file size limitations. Triggered or not triggered.
Dual	Combination of sweeps and continuous mode: recorder type streaming to disk with simultaneously triggered sweeps in RAM.
Slow fast sweep	A triggered acquisition in RAM which includes an acquisition phase with a higher sample rate, located at a point of interest.

Storage Modes	
Component	**Description**
Recorder	Spooled directly to hard-disk of control PC; unlimited file size or duration
Scope	Store in transient memory
Transient	Store in transient memory, single or A-B-A timebase

Miscellaneous		
Component	**Unit Description**	**Value**
Probe power	External connector can provide power for probe	9 V @ 0.4 A

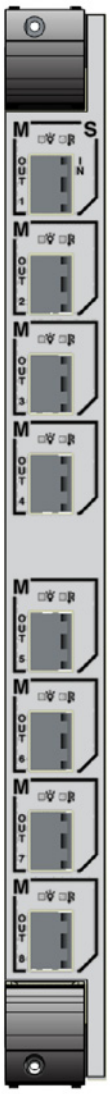
Ordering Information			
Component		**Unit Description**	**Order number**
Fast differential 25M		**Diff 25MS, 128M** 4 channel 25 MS/s Diff HighSpeed Digitizer, 128 MB RAM (16 MS/ch), 15 bit	1-GN413-2
Fast differential 100M		4 channel 100 MS/s Diff High-Speed Digitizer, 1800 MB RAM (225 MS/ch), 14 bit Digitizer	1-GN412-2

Accessories		
Model	**Unit Description**	**Order number**
2GB Memory Upgrade	2 GB Memory Upgrade for 100 MS/s digitizers and fiber receiver cards only (done at factory, includes re-calibration, for older cards with 800 MB memory)	1-G030-2

6.8 Master/Slave module

For fully synchronous operation between multiple mainframes the master/slave module is used. The **master/slave** module synchronizes clocks, triggering, pause/stop and start signals between all connected mainframes. Connections are made using fiber-optic cables.

This option allows for a multi-mainframe configuration to work as a single unit. Within a combination of mainframes, one mainframe is used as a master that can drive up to eight slaves.



6.8.1 Master/Slave Card

Master/Slave Card Specifications (Summary)		
Component	**Unit Description**	**Value**
Outputs	One master mainframe can drive up to eight slave mainframes	
Inputs	Combined with master output	1
M/S configuration	Star: one master mainframe can drive up to eight slave mainframes in a star configuration. No daisy-chaining	1
Cabling	Fiber-optic	
Connectors	Fiber-optic LC-type connectors	
Synchronization	Clock (timebase), trigger, qualifier, acquisition	

Master/Slave Card Specifications (Summary)		
Component	**Unit Description**	**Value**
Accuracy	Built-in delay measurements confine accuracy	≤ ± 50 ns
Distance	Between master and slave	Up to 300 m
Indicators	LED indicators per channel: one for connection status and one for data	2

Fiber-optic Cable Specifications		
Component	**Unit Description**	**Value**
Connector	LC® Duplex	
Transfer rate		2 GB
Wavelength		850 nm
Cable type	Multimode	50/125 µm
Dynamic range		+ 9 dB
Isolation		10^{15} Ω/m
Cable lengths		3 m 10 m 20 m
Maximum length	300 m using a single cable Maximum length will decrease by 100 m for each patch panel installed	300 m

Real-time Analysis	
Component	**Description**
StatStream ©	Each channel includes real-time extraction of Max, Min, Mean, Peak-to- Peak, and RMS values

Ordering Information			
Component		**Unit Description**	**Order number**
Master/ Slave		GEN DAQ MASTER / SLAVE Option - uses first slot in GEN16t rack and GEN2i and GEN5i integrated mainframes and special (leftmost) slot in GEN7t tower mainframe; needed in master and any slaves, up to eight slaves maximum; 3m fiber-optic cable included. Note: The GEN2i and GEN5i can only act as Master, not as Slave.	1-G040-2

6.8.2 Installation

One board is required in the master mainframe and one board is required per slave mainframe.

In the GEN series tower model the master/slave module is placed on the left-hand side of the controller/interface module. In the GEN series 19” rack model the master/slave module is placed on the right-hand side of the controller/ interface.

The following diagram gives an example of a master/slave configuration with a master driving five slave mainframes.

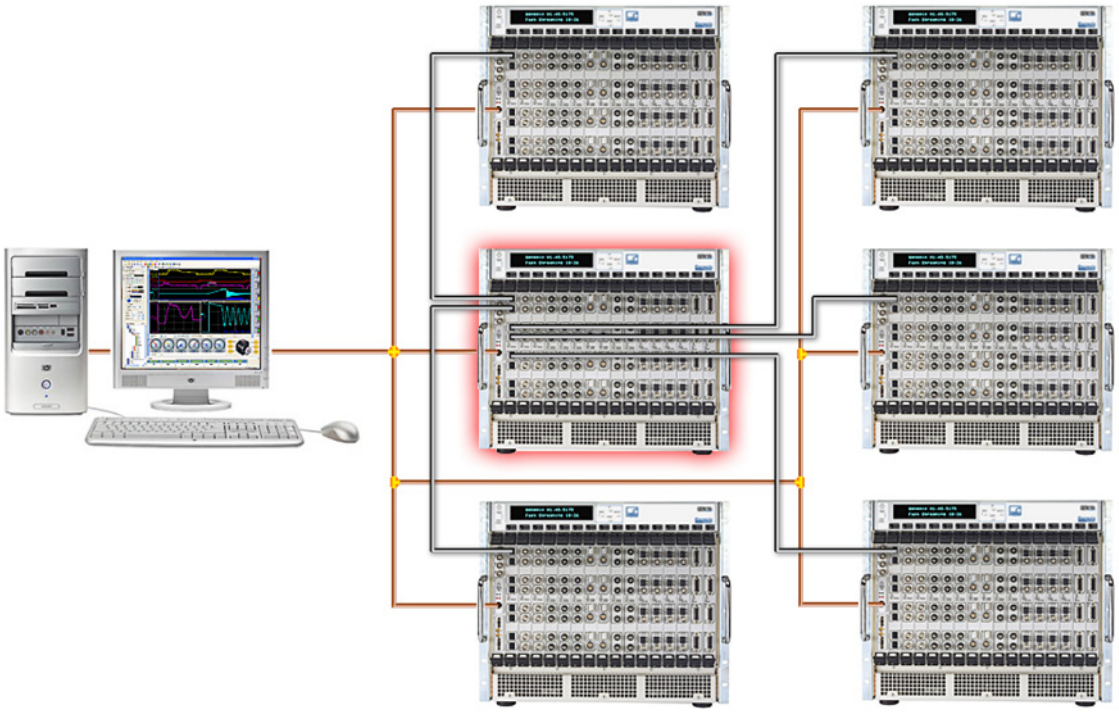


Figure 6.22: Master/Slave example

6.9 16/32 channel Basic Card 20kS/s

With the **16/32-channel Basic Card 20 kS** you get a no-compromise solution for high-channel-count data acquisition systems.

This card gives you:

- A cost-effective solution with 16 or 32 channels per card
- High precision with a 16-bit A-to-D convertor for each channel
- Sample rates up to 20 kS/s (both decimal and binary)
- Digital event support (on compatible mainframes only)
- 200 MB on-board memory

Up to 8 GEN mainframe “slaves” can be connected to a GEN7t/16t “master”; each of these 9 machines can contain up to 480 channels with this card (one slot required for master/slave operation), and all 4320 channels can measure in synchronization with each other.

And even the smallest member of the GEN series family, the portable GEN2i, can now house up to 64 channels.

The large amount of channels on this single card require special attention and are therefore equipped with 50-pin D connectors. To provide easy access to all channels, breakout cables are available as an option with 19 inch panels for BNC connectors.

Capabilities Overview			
Component		**Value**	
Model		**GN3211**	**GN1611**
Sample rate max		20 kS/s	20 kS/s
Memory per card		200 MB	200 MB
ADC resolution		16	16
Analog channels		32	16
Digital event channels (1)		16	16
Timer/Counter support		no	no
Input type			
	Analog	yes	yes

(1) When supported by mainframe

Note ***The listed specifications are valid for cards that are calibrated, and used in the same mainframe and slot as they were at the time of the calibration. When the card is removed from its original location and placed in another slot and/or mainframe the following specifications are invalidated: Offset error, gain error and MSE. Typically they can double.***

General Specifications

Analog and Global			
Component	**Unit Description**	**Value**	
Channels		**GN3211**	**GN1611**
		32	16
Input connectors	D-Sub (DD-50) connector	2	1
Input type	Differential (software switchable to single ended positive or negative), symmetrical	DC, AC, GND	
Input ranges	Given voltage spans apply where offset = 0	± 10 mV, ± 20 mV, ± 50 mV, ± 100 mV, ± 200 mV, ± 500 mV, ±1 V, ±2 V, ± 5 V, ±10 V, ± 20 V	
Offset	Zero position (except for the range 40 V)	± 50 %	
Offset error drift		± (10 ppm + 2µV)/°C	
Input impedance	In differential mode	2 x 1 MΩ (± 0.5 %) // 2 x 75 pF (± 15 %)	
Max static error	Total	± 0.015 % ± 25 µV	
Gain error		± 0.015 % ± 25 µV	
Gain error drift		± 10 ppm/°C	
Noise	Total	± 0.01 % ± 25 µV	
CMRR	In range <4 V	< -80 dB	
	In range ≥4 V	< -60dB	
CMV	In range <4 V	± 3 Vpeak	
	In range ≥4 V	± 50 Vpeak	
Input protection	Transient free	± 50 Vpeak	
Sample rate	High rates	10 S/s to 20 kS/s	
	Low rates (Low rate = High rate / n. Where n is an integer ≥ 2	1 S/s to 10 kS/s	
Binary sample rate	Supported	Yes	
External time base	Supported	Yes	

Analog and Global			
Component	**Unit Description**		**Value**
Filter selection			
Bandwidth	Wideband selected		20 kHz @ -3 dB
	Flatness up to 5 kHz	All ranges	+0 dB/-0.4 dB
Digital Decimation Filters			
Time Domain	12-pole Bessel style IIR, sample rate divided by 10, 20, 40 and 100		
	Minimum filter frequency		40 Hz @ -3dB
Frequency Domain	12-pole Butterworth style IIR, sample rate divided by 4, 10, 20 and 40		
	Minimum filter frequency		100 Hz @ -3dB
Measurement category	IEC 61010		CAT 1

Wideband (20 kHz) Characteristics
Component

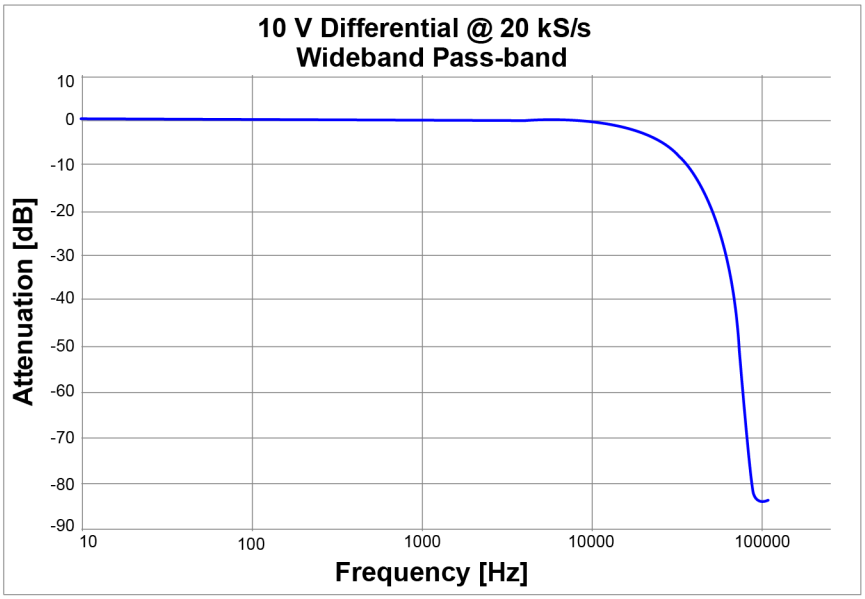


Figure 6.23: 10 V Differential @ 20 kS/s

Wideband (20 kHz) Characteristics
Component

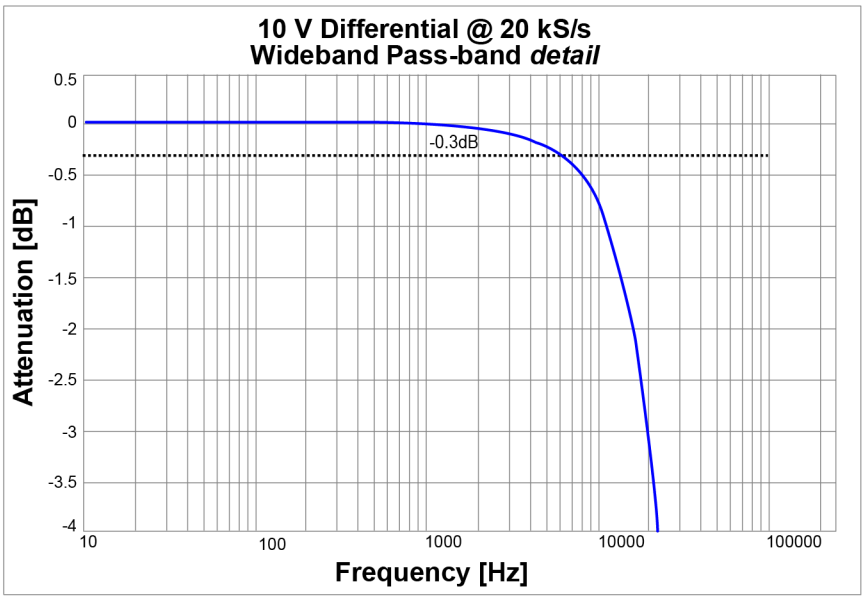


Figure 6.24: 10 V Differential @ 20 kS/s - Detail

Digital Functionality *Only available when the mainframe provides a complementary connector*			
Component		**Unit Description**	**Value**
Event inputs			
	Number of		16
	Levels	User can invert value in software	High (1)/Low (0)
Event/Status outputs			
	Number of		2
	Status output	Acquisition status	High when active
	Event output	Trigger or Alarm; user programmable	
Event out			
	Duration		Pulse of 12.8 µs
	Delay		200 µs ± 1 µs ± 1 sample

Triggering			
Component		**Unit Description**	**Value**
Triggered acquisition		Pretriggered acquisitions, with user selectable pre- and post trigger	
Trigger detector		The trigger detector flags a user-defined situation on the input signal to start an acquisition sequence (trigger) or to arm the acquisition (qualifier). Digital functionality applies to event channels.	1 per channel
	Functionality	Analog trigger modes	2
		Digital trigger modes	1
		Digital qualifier modes	1
	Levels	Analog: individual levels	2
		Digital	1
	Resolution	Analog: for each level; covers the selected Full Scale	16 bit (0.0015 %)
		Digital	1 bit
	Hysteresis	Defines the trigger levels insensitivity (analog only)	0.1 % to 100 % of FS
Pre-trigger length		Independent of storage medium used	0 to 100 % of recording length
Post trigger length		With sweep acquisition	0 to full on-board RAM
		Continuous type acquisition	0 to full HD capacity
Trigger rate		Up to 400 triggers per second, with zero re-arm time	1 per 2.5 ms
Trigger total		Maximum number of triggers per recording	10,000
Cross-channel operation		Triggers of all channels	Logical OR
		Qualifiers of all event channels	Logical AND
Analog trigger modes			
	Basic	Single level	Positive or negative level crossing
	Dual level	Two individual levels, OR-ed	One positive and one negative level crossing
Digital (event) trigger modes			
	Basic	Single change of state	Rising or falling edge

Triggering			
Component		**Unit Description**	**Value**
Digital (event) qualifier modes			
	Basic	Arm the acquisition with a single change of state	Rising or falling edge

Acquisition and Storage Modes			
Component		**Unit Description**	**Value**
Modes			
	Sweeps	Triggered acquisition to an on-board Random Access Memory (RAM) without sample rate limitations.	
	Continuous	Direct triggered acquisition to a PC or mainframe hard disk without file size limitations. Triggered or untriggered.	
	Dual	Combination of sweeps and continuous mode: continuous type streaming acquisition to disk with simultaneously triggered sweeps in RAM.	
	Slow fast sweep	A triggered acquisition in RAM which includes an acquisition phase with a higher sample rate, located at a point of interest.	
	Sample width		16 bit/sample
Acquisition			
	Sample memory		200 MB

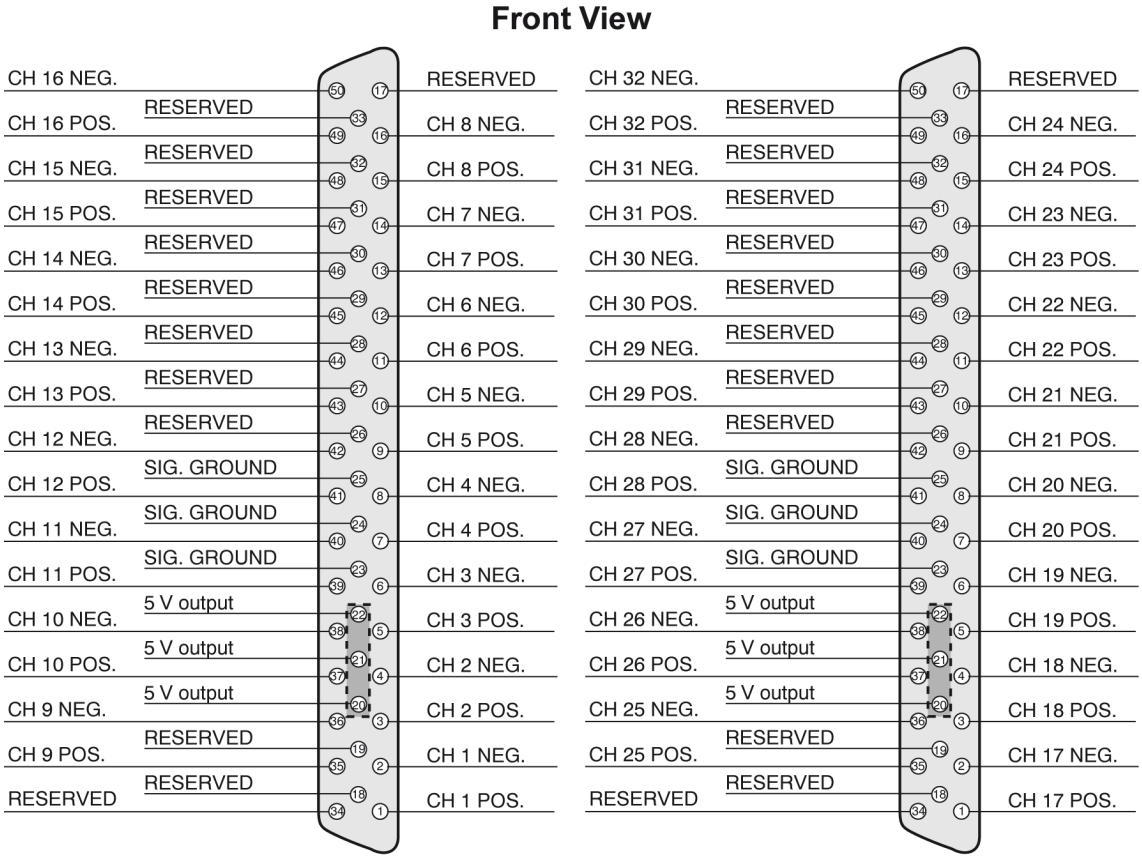


Figure 6.25: Pin diagram for top 16 Ch Connector (left), Bottom 16 Ch connector (right, 32 Ch Card only)

Note *Both positive and negative pins must be connected to avoid erroneous measurement results with noise.*

Note *There are 3 output pins available on each connector giving 5 V at 0.3 A in total from an automatic resettable fuse.*

Ordering Information			
Model		**Unit Description**	**Order number**
GN3211		32 Channel 20 kS/s per channel Differential digitizer, 200 MB RAM per card, 16 bit.	1-GN3211-2
GN1611		16 Channel 20 kS/s per channel Differential digitizer, 200 MB RAM per card, 16 bit.	1-GN1611-2

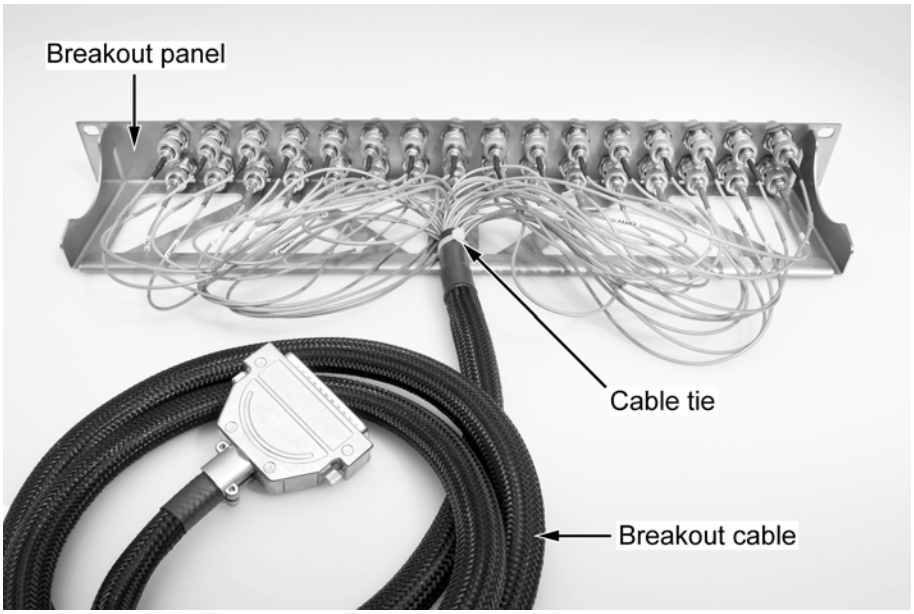


Figure 6.26: Breakout panel and cable

Accessories			
Model		**Unit Description**	**Order number**
KAB171		16 ch single ended break out cable, HDSub to 16x BNC, 2 m; for use with GEN DAQ 16/32 ch input card	1-KAB171-1-2
KAB172		16 ch differential break out cable, HDSub to 32x BNC, 2 m; for use with GEN DAQ 16/32 ch input card	1-KAB172-1-2
G055		16 ch single ended 19 inch or 1 U (44.45 mm) breakout panel; 16 BNC feed-through; to be used with 16 ch single ended break out cable	1-G055-2
G056		16 ch differential 19 inch or 1 U (44.45 mm) breakout panel; 16 x 2 BNC feed-through; to be used with 16 ch differential break out cable	1-G056-2
G058		32 ch single ended 19 inch or 1 U (44.45 mm) breakout panel; 32 BNC feed-throughh; to be used with two 16 ch single ended breakout cables	1-G058-2

6.10 16/32 channel Accel Card 250 kS/s

With the **16/32-channel Accel Card 250 kS** you get a no-compromise solution for high channel count data acquisition systems.

This card gives you:

- A cost-effective solution with 16 or 32 channels per card
- High precision with a 24-bit A-to-D convertor for each channel
- Sample rates up 250 kS/s (both decimal and binary)
- Flexibility; each channel can be individually assigned one of the following signal conditioners:
  - IEPE for accelerometers, microphones, etc.
  - Charge for pressure transducers, piezoelectric accelerometers, etc.
  - Voltage (full differential and single-ended)
- TEDS readout support for IEPE transducers
- Digital event and timer-counter support (on compatible mainframes only)
- 1.8 GB on-board memory

Up to 8 GEN mainframe “slaves” can be connected to a GEN7t/16t “master”; each of these 9 machines can contain up to 480 channels with this card (one slot required for master/slave operation), and all 4320 channels can measure in synchronization with each other.

And even the smallest member of the GEN series family, the portable GEN2i, can now house up to 64 channels.

The large amount of channels on this single card require special attention and are therefore equipped with 50-pin D connectors. To provide easy access to all channels breakout cables are available as an option with 19 inch panels for BNC connectors.

Capabilities Overview			
Component		**Value**	
Model		**GN3210**	**GN1610**
Sample rate max		250 kS/s	250 kS/s
Memory per card		1800 MB	1800 MB
ADC resolution (1)		16/24 bits	16/24 bits
Analog channels		32	16
Digital event channels (2)		16	16
Timer/Counter support (2)(3)		yes	yes
Input type			
	Analog	yes	yes

Capabilities Overview			
Component		**Value**	
	IEPE	yes	yes
	Charge	yes	yes
	TEDS support (4)	yes	yes

(1) Software selectable

(2) When supported by mainframe

(3) When in 24-bit mode

(4) When IEPE selected

Note ***The listed specifications are valid for cards that are calibrated, and used in the same mainframe and slot as they were at the time of the calibration. When the card is removed from its original location and placed in another slot and/or mainframe the following specifications are invalidated: Offset error, gain error and MSE. Typically they can double.***

General Specifications

Analog and Global			
Component	**Unit Description**	**Value**	
Channels		**GN3210**	**GN1610**
		32	16
Input connectors	D-Sub (DD-50) connector	2	1
Input type	Differential (software switchable to single-ended positive or negative), symmetrical	DC, AC, GND	
Input ranges	Given voltage spans apply where offset = 0	± 10 mV, ± 20 mV, ± 50 mV, ± 100 mV, ± 200 mV, ± 500 mV, ± 1 V, ± 2V, ± 5 V, ± 10 V, ± 20 V	
Offset	Zero position (except for the 40 V range)	± 50 % Full scale	
Offset error drift		± (10 ppm + 2 µV)/°C	
Input impedance		2 x 1 MΩ (± 0.5 %) // 2 x 75 pF (± 15 %)	
Max static error	Total	± 0.015 % ± 25 µV	
Gain error		± 0.015 % ± 25 µV	
Gain error drift		± 10 ppm/°C	
Noise	Total	± 0.01 % ± 25 µV	

Analog and Global			
Component	**Unit Description**		**Value**
CMRR	In range <4 V		< -80 dB
	In range ≥4 V		< -60 dB
CMV	In range <4 V		± 3 Vpeak
	In range ≥4 V		± 50 Vpeak
Input protection	Transient free		± 50 Vpeak
Sample rate	High rates		10 S/s to 250 kS/s
	Low rates (Low rate = High rate / n, where n is an integer ≥ 2)		1 S/s to 125 kS/s
Binary sample rate	Supported		Yes
External time base	Supported		Yes
Filter selection			
Bandwidth	250 kS/s and 125 kS/s (Sigma Delta wideband selected)		100 to 105 kHz @ -3 dB
	Bandwidth @ All other sample rates		80 to 85 kHz @ -3 dB
	Flatness up to 100 kHz	In range < 4 V	+0 dB/-0.3 dB
		In range ≥ 4 V	+0.2 dB/-0.4 dB
Digital Decimation Filters			
Time Domain	12(1) -pole Bessel style IIR, sample rate divided by 10, 20, 40 and 100		
	Minimum filter frequency		40 Hz @ -3dB
Frequency Domain	12-pole Butterworth style IIR, sample rate divided by 4, 10, 20 and 40		
	Minimum filter frequency		100 Hz @ -3dB
Measurement category	IEC 61010		CAT 1

(1) Bessel style IIR filter frequencies, 25 kHz and 20 kHz are 8-pole.

Filter Characteristics
Component

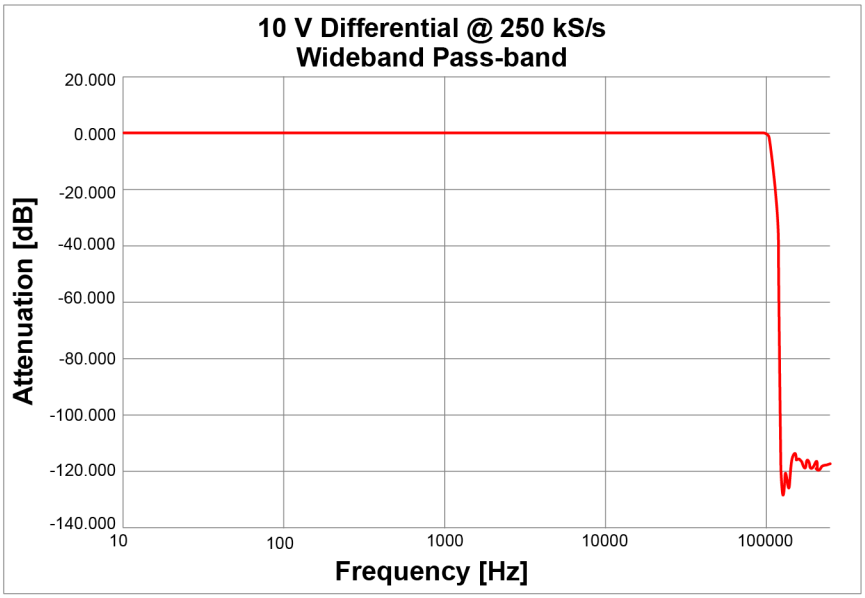


Figure 6.27: 10 V Differential @250 kS/S

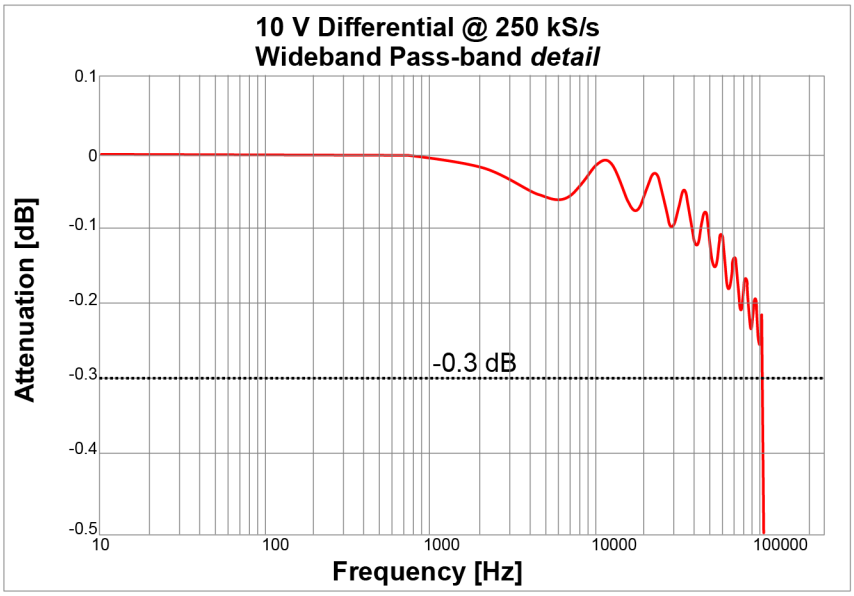


Figure 6.28: 10 V Differential @250 kS/S - Detail

Filter Characteristics
Component

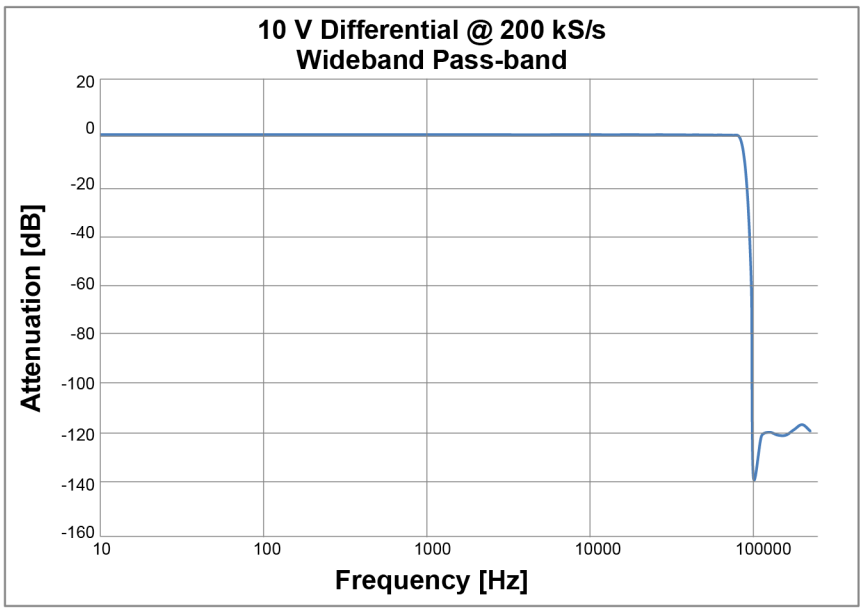


Figure 6.29: 10 V Differential @200 kS/S

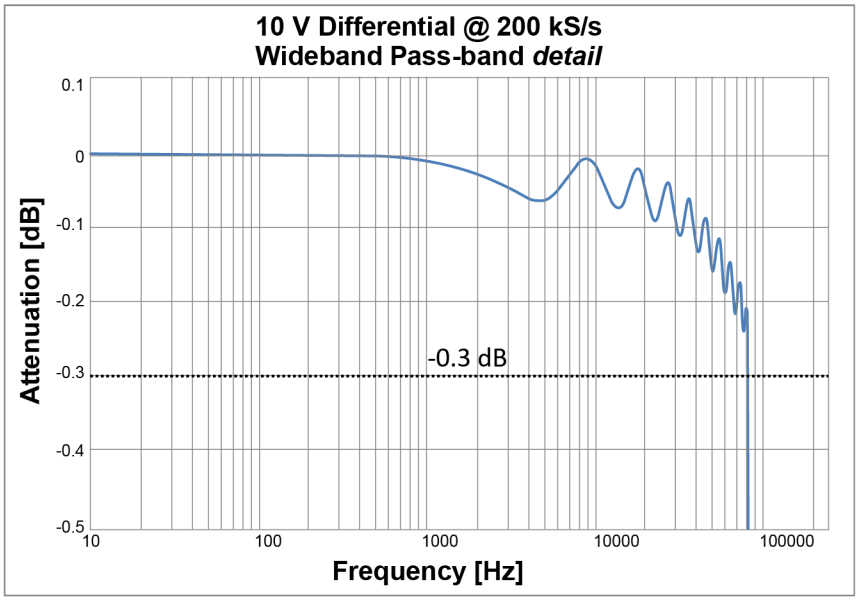


Figure 6.30: 10 V Differential @200 kS/s - Detail

IEPE Amplifier			
Component		**Unit Description**	**Value**
Input ranges			± 10 mV, ± 20 mV, ± 50 mV, ± 100 mV, ± 200 mV, ± 500 mV, ± 1 V, ± 2V, ± 5 V, ± 10 V, ± 20 V
Over voltage protection			-1 V to 22 V
IEPE gain error		All ranges	± 0.1 % ± 300 µV
IEPE gain error drift			± 10 ppm/°C
Sensor compliance voltage			22 V
Sensor excitation current		Software selectable	2 mA, 4 mA, 6 mA and 8 mA
	Excitation accuracy		± 5 %
	Coupling time constant		1.5 s
	Lower bandwidth		-3 dB @ 0.11 Hz
	Sensor ID readout		TEDS
	Maximum cable length		100 m (RG-58)

Charge Amplifier		
Component	**Unit Description**	**Value**
Input ranges		± 10 pC, ± 20 pC, ± 50 pC, ± 100 pC, ± 200 pC, ± 0.5 nC, ± 1 nC, ± 2 nC
Over voltage protection		± 30 Vpeak
Charge gain error		± 2 %
Charge gain error drift		± 30 ppm/°C

Charge Amplifier		
Component	**Unit Description**	**Value**
Lower bandwidth limit		-3 dB @ 1 Hz
Upper bandwidth limit	1 nF source capacity	-3 dB @ 10 kHz

Digital Functionality *Only available when the mainframe provides a complementary connector*			
Component		**Unit Description**	**Value**
Event inputs			
	Number of		16
	Levels	User can invert value in software	High (1)/Low (0)
Event/Status outputs			
	Number of		2
	Status output	Acquisition status	High when active
	Event output	Trigger or Alarm; user programmable	
Event out			
	Duration		Pulse of 12.8 µs
	Delay		200 µs ± 1 µs ± 1 sample
Timer/counter functionality			
		Uses three event input channels. You can use timer/counter functionality in parallel with the used event input channels	• Counter • Frequency counter • Quadrature decoder
Counter			
	Functionality	Up/down counter with reset	
	Inputs	• Count • Up/down • Reset	
	Range	Count up or down with a 32-bit counter	0 - 4 294 967 295 (4 GB)
	Frequency	Maximum input frequency	5 MHz
	Reset	One of four modes: • Software controlled (manual) • On Start of Acquisition • On external trigger once • Always on external trigger	

Digital Functionality *Only available when the mainframe provides a complementary connector*			
Component		**Unit Description**	**Value**
Frequency counter			
	Functionality	Frequency and RPM measurement with external direction input and reset	
	Inputs	• Measure • Direction • Reset	
	Frequency	Maximum input frequency	5 MHz
	Accuracy	Measurement accuracy	0.1 %
	Gate time	Measurement gate time, user selectable	5 ms to 50 s
	Reset	One of four modes: • Software controlled (manual) • On Start of Acquisition • On external trigger once • Always on external trigger	
Quadrature decoder			
	Functionality	Quadrature decoding with reset	
	Inputs	• Signal A • Signal B • Reset	
	Frequency	Maximum input frequency	5 MHz
	Accuracy	The number of edges in the input signals used per cycle to determine position.	1: Single precision 2: Dual precision 4: Quadruple precision
	Count	Maximum count equals counter width divided by precision 'N'	32 bit/N
	Reset	One of four modes: • Software controlled (manual) • On Start of Acquisition • On external trigger once • Always on external trigger	
Status output			
	Functionality	Outputs status. One event for "Acquisition active" and one for "Trigger" or "Alarm" under user control	
	Outputs	• Acquisition active • Trigger/alarm	
	Acquisition active	Active high when recording. Low in idle and pause mode	Level

Digital Functionality *Only available when the mainframe provides a complementary connector*			
Component		**Unit Description**	**Value**
	Pulse width	Trigger output pulse	12.8 µs
	Delay	Delay from actual event to output	200 µs ± 1 µs ± 1 sample

Triggering			
Component		**Unit Description**	**Value**
Triggered acquisition		Pretriggered acquisitions, with user selectable pre- and post trigger	
Trigger detector		The trigger detector flags a user-defined situation on the input signal to start an acquisition sequence (trigger) or to arm the acquisition (qualifier). Digital functionality applies to event channels.	1 per channel
	Functionality	Analog trigger modes	2
		Digital trigger modes	1
		Digital qualifier modes	1
	Levels	Analog: individual levels	2
		Digital	1
	Resolution	Analog: for each level; covers the selected Full Scale	16 bit (0.0015 %)
		Digital	1 bit
	Hysteresis	Defines the trigger levels insensitivity (analog only)	0.1 % to 100 % of FS
Pre-trigger length		Independent of storage medium used	0 to 100 % of recording length
Post trigger length		With sweep acquisition	0 to full on-board RAM
		Continuous type acquisition	0 to full HD capacity
Trigger rate		Up to 400 triggers per second, with zero re-arm time	1 per 2.5 ms
Trigger total		Maximum number of triggers per recording	10,000
Cross-channel operation		Triggers of all channels	Logical OR

Triggering			
Component		**Unit Description**	**Value**
		Qualifiers of all event channels	Logical AND
Analog trigger modes			
	Basic	Single level	Positive or negative level crossing
	Dual level	Two individual levels, OR-ed	One positive and one negative level crossing
Digital (event) trigger modes			
	Basic	Single change of state	Rising or falling edge
Digital (event) qualifier modes			
	Basic	Arm the acquisition with a single change of state	Rising or falling edge

Acquisition and Storage Modes			
Component		**Unit Description**	**Value**
Modes			
	Sweeps	Triggered acquisition to an on-board Random Access Memory (RAM) without sample rate limitations.	
	Continuous	Direct triggered acquisition to a PC or mainframe hard disk without file size limitations. Triggered or untriggered.	
	Dual	Combination of sweeps and continuous mode: continuous type streaming acquisition to disk with simultaneously triggered sweeps in RAM.	
	Slow fast sweep	A triggered acquisition in RAM which includes an acquisition phase with a higher sample rate, located at a point of interest.	
	Sample width	When acquiring 16 bit data.	16 bit/sample
		When acquiring 24 bit data and/or using counter timer channels.	32 bit/sample
Acquisition			
	Sample memory		1800 MB

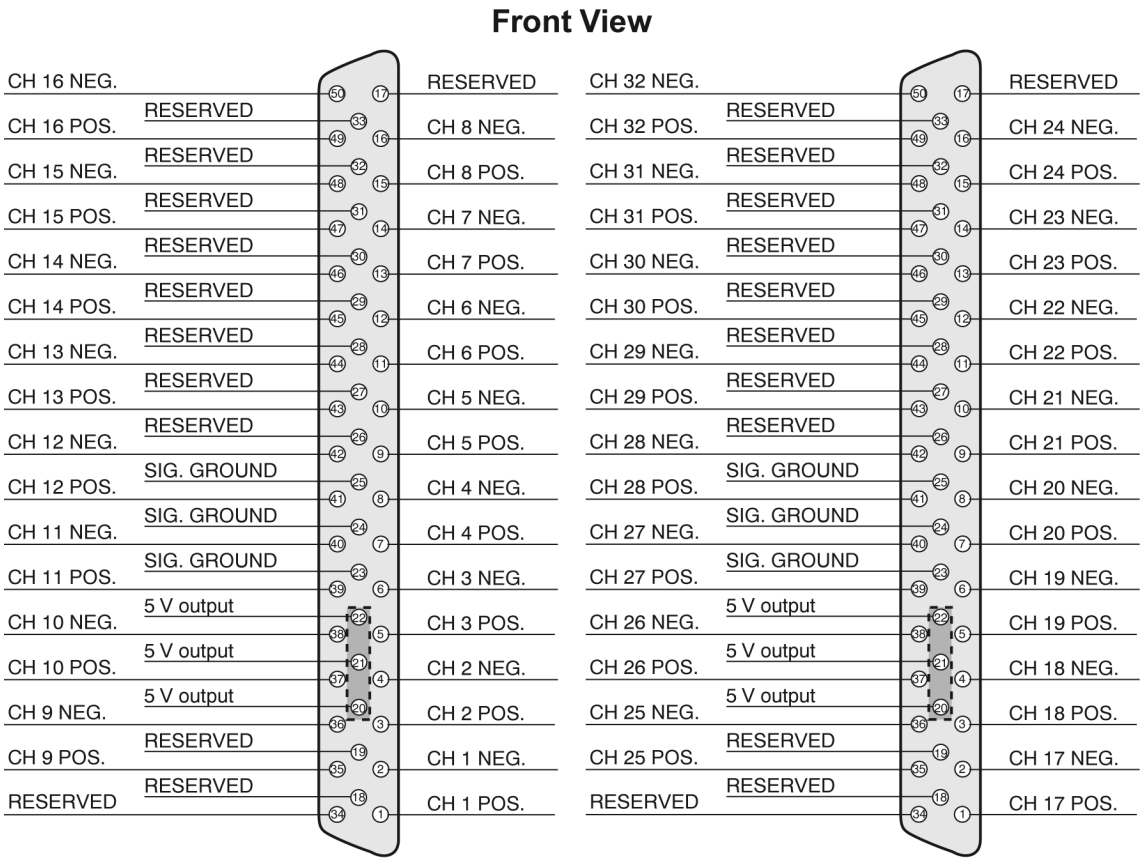


Figure 6.31: Pin diagram for top 16 Ch Connector (left), Bottom 16 Ch connector (right, 32 Ch Card only)

Note *Both positive and negative pins must be connected to avoid erroneous measurement results with noise.*

Note *There are 3 output pins available on each connector giving 5 V at 0.3 A in total from an automatic resettable fuse.*

Ordering Information			
Model		**Unit Description**	**Order number**
GN3210		32 Channel 250 kS/s per channel Differential digitizer, 1800 MB RAM per card, 16/24 bit, IEPE, TEDS and charge support	1-GN3210-2
GN1610		16 Channel 250 kS/s per channel Differential digitizer, 1800 MB RAM per card, 16/24 bit, IEPE, TEDS and charge support	1-GN1610-2

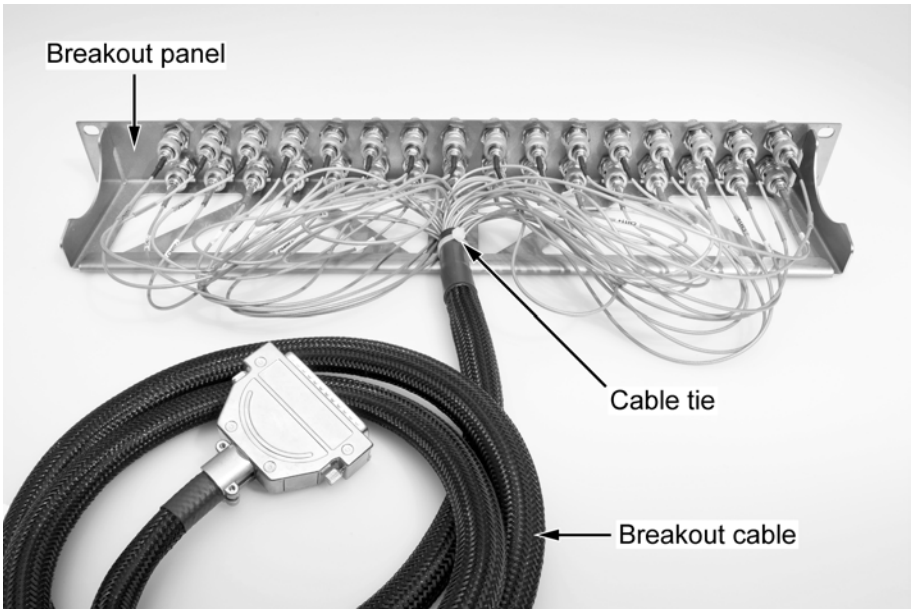


Figure 6.32: Breakout panel and cable

Accessories			
Model		**Unit Description**	**Order number**
KAB171		16 ch single ended break out cable, HDSub to 16x BNC, 2 m; for use with GEN DAQ 16/32 ch input card	1-KAB171-1-2
KAB172		16 ch differential break out cable, HDSub to 32x BNC, 2 m; for use with GEN DAQ 16/32 ch input card	1-KAB172-1-2
G055		16 ch single ended 19 inch or 1 U (44.45 mm) breakout panel; 16 BNC feed-through; to be used with 16 ch single ended break out cable	1-G055-2
G056		16 ch differential 19 inch or 1 U (44.45 mm) breakout panel; 16 x 2 BNC feed-through; to be used with 16 ch differential break out cable	1-G056-2
G058		32 ch single ended 19 inch or 1 U (44.45 mm) breakout panel; 32 BNC feed-throughh; to be used with two 16 ch single ended breakout cables	1-G058-2

7 Interface Module/System Controller

7.1 Introduction

The Interface Module runs a high-end CPU with an embedded real-time operating system. It can store data to local (RAM) memory, optional extras are available for storage and communication, for more details see “GEN series Options” on page 207. Each mainframe houses an Interface Module which enables data input and output so that mainframes can be networked together. The Interface Module runs a high-end CPU with an embedded real-time operating system. It can store data to local (RAM) memory, optional extras are available for storage and communication, for more details see chapter “GEN series Options” on page 207.
From late 2011 an upgraded Interface Module will be shipped as standard with all mainframes. There will then exist two different Interface Module versions:

- Interface Module 1 (IM1)
- Interface Module 2 (IM2)

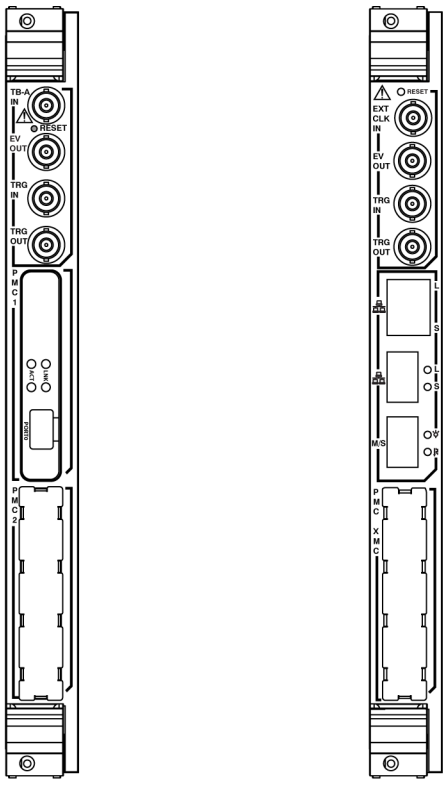
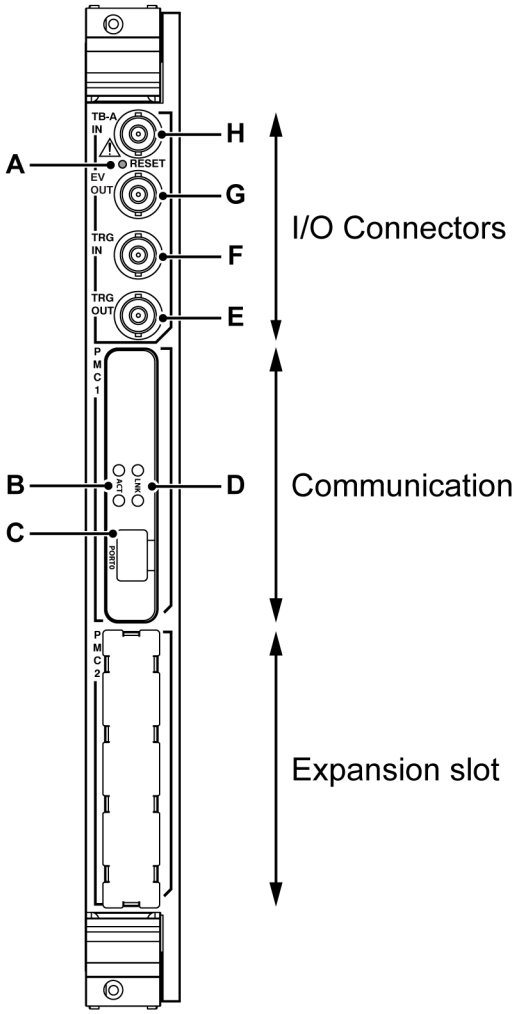


Figure 7.1: Interface modules (IM1-left) (IM2-right)

If you are not sure which Interface Module you have in your mainframe please contact your local sales representative or send an email to info@hbm.com. In both cases please provide us with the serial number of your mainframe. You will find this number at the label on the rear side of the mainframe.

7.1.1 Interface Module 1 (IM1)

The following diagram shows the front panel layout of the interface modules/ system controllers IM1.



A Recessed CPU Reset Switch

B Activity detected

C RJ-45 Connector/Ethernet Port

D Link detected

E External Trigger Out

F External Trigger In

G External Event Out

H External Timebase In

The CPU **Reset** Switch can be used to reset the controller/interface in the rare event of a system malfunction. To reset the unit carefully press the recessed switch with a small screwdriver or equivalent.

7.1.2 Ethernet interface

The GEN series uses standard TCP/IP protocol over Ethernet to communicate with your PC. The system controller/Interface Modules provides access to the Ethernet network. Unshielded Twisted Pair (UTP) cable of Category 5E (Cat5e) or greater may be used up to 30 meters in length.

The module is equipped with an interface with 100/1000 Base-T Gigabit support. You must connect to the RJ-45 connector.

For full details on how to connect the GEN series with a PC see "Connecting to the network" on page 44.

LED's are used to indicate activity as well as connection.

Communication and control		
Component	**Unit Description**	**Value**
Interface	Ethernet, Cat 5e UTP	1 Gbit/s
Transfer speed	Typical direct-to-PC transfer speed for streaming mode acquisitions	6.4 MS/s (12.8 MB/s)

7.1.3 I/O connectors (IM1)

The controller/interface provides 4 BNC connectors with the following functions:

- **External Timebase In**
  This input can be used to provide another timebase for the ADC rather than the internal one. Typically used in combination with rotating machinery where the ADC clock is synchronized with the revolutions. In the Perception software the selection between external and internal timebase is made in the Mainframe section of the Settings.
- **External Event Out**
  This output is software selectable between **Alarm Out** and **Recording Active Out.** When *alarm* is selected, the output is driven by channel alarm detectors. When *recording active* is selected, the output is "high" when a recording is in progress.
- **External Trigger In/Out**
  This input and output are related to the recorder trigger logic. For details see "Recorder and system trigger" on page 260.

Available Options for IM1

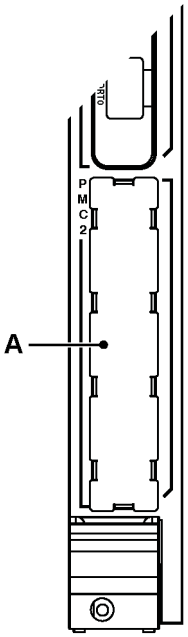


Figure 7.2: Free slot on system controller

A Free space for option

IM1 Expansion board options:

- IRIG (1-G001-2)
- IRIG/GPS (1-G002-2)
- SCSI (1-G004-2)

Upgrade option:

- Fiber-optic Ethernet interface (1-G050-2)

Note *For more details please see description in “GEN series Options” on page 207.*

I/O Specifications (Connectors)			
Component		**Unit Description**	**Value**
External timebase in			
	TTL compatible		
	Duty cycle		50 %
	Pulse width		200 ns min.
	Maximum frequency		2.5 MHz

I/O Specifications (Connectors)			
Component		**Unit Description**	**Value**
	Edge	Rising only	
	Resolution	1 MS/s boards	1.01 µs
		100 MS/s boards	60 ns
	Delay	From BNC to sample moment	350 - 400 ns
	Overvoltage		± 30 V
Event Out			
		TTL compatible	
	Level active	Selectable Alarm High Level, Alarm Low Level or Recording High Level	
	Output impedance		50 Ω
Trigger In			
	TTL compatible		
	Resolution		50 ns
	Minimum pulse width		500 ns
	Overvoltage		± 30 V
Trigger Out (1) (2)			
	TTL compatible		
	Edge active	Selectable	
	Pulse width	(Minimum 10 µs)	12.8 µs
	Output impedance		50 Ω
Expansion Slot Options			
	Add ons	IRIG, SCSI, IRIG/GPS	1

(1) Trigger-Out will not show a trigger when Trigger-In is used at the same time. This option is software selectable.

(2) Standard delay of 514 µs from actual trigger to output.

I/O Specifications (Summary)			
Component		**Unit Description**	**Value**
Timebase (1)			
	Accuracy	For internal sources	< 30 ppm
	Base	Binary, Decimal or External	

I/O Specifications (Summary)			
Component		**Unit Description**	**Value**
	External	Actual sample rate is dependant on and maybe limited by the input module used	5 MS/s
Synchroniszation			
	Master/Slave	Synchronization through master slave module	
Local Control			
	Display	2 lines of 20 characters of information and status	
	Control	Network and system setup	
	Status	Timebase sync source	
	Warning	Ethernet/Disk software version conflicts	

(1) The GEN series mainframes provide a central timebase for all acquisition modules.

External I/O Delay Specification			
Component	**Unit Description Delay (µs) (1)**	**Clock Base**	**Filter(2)**
Ext. Trig In	0 ± 1µs + ≤1Tsmp	Decimal	Wideband
Ext. Trig Out	516 ± 1µs + ≤1Tsmp	Decimal	Wideband
Alarm Out	515 ± 1µs + ≤1Tsmp	Decimal	Wideband
Ext. Trig In	0 ± 1µs + ≤1Tsmp	Binary	Wideband
Ext. Trig Out	504 ± 1µs + ≤1Tsmp	Binary	Wideband
Alarm Out	503 ± 1µs + ≤1Tsmp	Binary	Wideband

Tsmp = Sample period in µs

(1) Delays are equal for all acquisition modules.

(2) If filter is used delay will vary depending on type of filter and signal frequency. Delay becomes unpredictable.

Communication and control			
Component		**Description**	**Value**
Interface		1 Gigabit Ethernet Cat 5e UTP	
	Replacement option	Fiber-optic ethernet interface	

Communication and control		
Component	**Description**	**Value**
Transfer Speed	Transfer speed direct-to-PC or streaming; mode acquisitions	12.8 MB/s

7.1.4 Interface Module 2 (IM2)

The following diagram Figure 7.3 shows the front panel layout of the interface modules/system controllers IM2.

Note *The IM2 is planned for release for the end of 2011.*

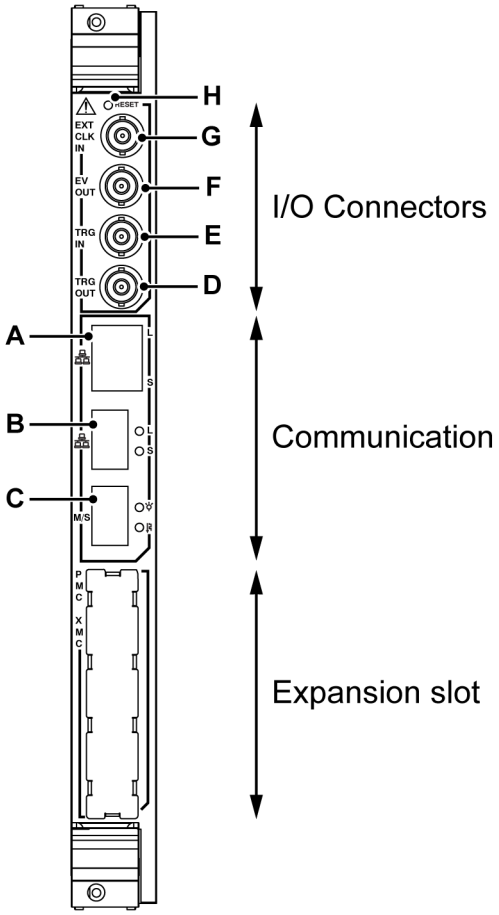


Figure 7.3: Interface module 2

A RJ-45 Connector/Ethernet Port

B SPF Ethernet connector/SFP Port

C Synchronized recording

D External Trigger Out

E External Trigger In

F External Event Out

G External Timebase In

H Recessed Mainframe Reset Switch

The CPU **Reset** Switch can be used to reset the controller/interface in the rare event of a system malfunction. To reset the unit carefully press the recessed switch with a small screwdriver or equivalent.

7.1.5 Interface Module 2 - Communication and Control interface

The GEN series uses standard TCP/IP protocol over Ethernet to communicate with your PC. The system controller/Interface Modules provides access to the Ethernet network. Unshielded Twisted Pair (UTP) cable of Category 5E (Cat5e) or greater may be used up to 30 meters in length.

The module is equipped with:

- 1 copper Ethernet interface with 100/1000 Base-T Gigabit support (connect to the RJ-45 connector).
- 1 Fiber-optic interface (connect to the SFP module option).

LED's are used to indicate activity as well as connection.

Communication and control		
Component	**Unit Description**	**Value**
Interface	Ethernet, Cat 5e UTP	1 Gbit/s
Transfer speed	Now up to (1)	100 MB/s
	Typical to local storage	50 MB/s

(1) Tested using a limited combination of acquisition boards.

7.1.6 I/O connectors (IM2)

The controller/interface provides 4 BNC connectors with the following functions:

- **External Timebase In**
  This input can be used to provide another timebase for the ADC rather than the internal one. Typically used in combination with rotating machinery where the ADC clock is synchronized with the revolutions. In the Perception software the selection between external and internal timebase is made in the Mainframe section of the Settings.
- **External Event Out**
  This output is software selectable between **Alarm Out** and **Recording Active Out.** When *alarm* is selected, the output is driven by channel alarm detectors. When *recording active* is selected, the output is "high" when a recording is in progress.
- **External Trigger In/Out**
  This input and output are related to the recorder trigger logic. For details see "Recorder and system trigger" on page 260.

Available Options for IM2, PMC2

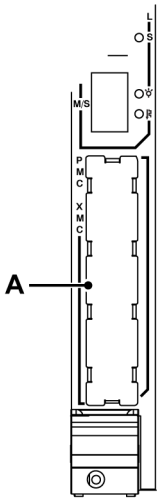


Figure 7.4: Free slot on system controller

A Free space for option

IM2 Expansion board options:

- IRIG (1-G001-2)
- IRIG/GPS (1-G002-2)

Add-on options:

- Optical Network 850 nm (1-G062-2)
- Optical Network 1310 nm (1-G063-2)

On-board options:

- Solid State Disc (1-G061-2)

Note *This is only a list of available options, for more details please see description in “GEN series Options” on page 207.*

Synchronized Recording LEDs functionality	
Component	**Unit Description**
ON	Correct Mst/Slv link, fiber cable connected
OFF	No Fiber cable connected
Flashing	Fiber cable connected, onboard Mst/Slv disabled (Disabled by user or by present Mst/Slv module)

I/O Specifications (Connectors)				
Component			**Unit Description**	**Value**
External timebase in				
			TTL compatible	
	Pulse width			100 ns min.
	Maximum frequency			5 MHz
	Edge		Rising	
	Resolution		1 MS/s boards	1.01 µs
			100 MS/s boards	60 ns
	Delay		From BNC to sample moment	350 - 400 ns
	Overvoltage			± 30 V
Event Out - Short circuit protected (continuous)				
			TTL compatible	
			Level active	
	Output impedance			50 Ω
Trigger In				
			TTL compatible	
	Resolution		Selectable	50 ns
	Minimum pulse width			500 ns
	Overvoltage		Edge selectable	± 30 V
Trigger Out (1) (2)				
	TTL compatible			
	Edge active		Selectable	
	Pulse width			12.8 µs
	Output impedance			50 Ω
Expansion Slot Options				
	Add ons	IM2	IRIG, IRIG/GPS	1

(1) Trigger-Out will not show a trigger when Trigger-In is used at the same time. This option is software selectable.

(2) Standard delay of 514 µs from actual trigger to output, depending on board used.

I/O Specifications (Summary)			
Component		**Unit Description**	**Value**
Timebase (1)			
	Accuracy	For internal sources	< 15 ppm
	Base	Binary, Decimal or External	
Synchronization (2)			
	Mainframes	With Synchronization between multiple mainframes	
Local Control			
	Display	2 lines of 20 characters of information and status	
	Control	Network and system setup	
	Status	Timebase sync source	
	Warning	Ethernet/Disk software version conflicts	

(1) The GEN series mainframes provide a central timebase for all acquisition modules.

(2) Synchronization is only currently available for the GEN2i.

Note *When the Master/Slave Board is used in the extension slot of the mainframe the internal Synchronized Recording is disabled.*

External I/O Delay Specification			
Component	**Unit Description Delay (µs) (1)**	**Clock Base**	**Filter(2)**
Ext. Trig In	0 ± 1µs + ≤1Tsmp	Decimal	Wideband
Ext. Trig Out	516 ± 1µs + ≤1Tsmp	Decimal	Wideband
Alarm Out	515 ± 1µs + ≤1Tsmp	Decimal	Wideband
Ext. Trig In	0 ± 1µs + ≤1Tsmp	Binary	Wideband
Ext. Trig Out	504 ± 1µs + ≤1Tsmp	Binary	Wideband
Alarm Out	503 ± 1µs + ≤1Tsmp	Binary	Wideband

Tsmp = Sample period in µs

(1) Delays are equal for all acquisition modules.

(2) If filter is used delay will vary depending on type of filter and signal frequency. Delay becomes unpredictable.

8 GEN series Options

8.1 Introduction

Your GEN series data acquisition system can be equipped with a variety of options. Most options are factory-installed, i.e. you must choose an option at ordering time or return the instrument to a qualified service point for upgrade.

System controller board

The system controller boards of the GEN series mainframe has one expansion slot that can be used for one of the following options:

System controller board	
Option	**Supported by**
IRIG (1-G001-2)	IM1 and IM2
IRIG/GPS (1-G002-2)	IM1 and IM2
SCSI (1-G004-2)	IM1 only
Fiber-optic Ethernet (1-G050-2)	IM1 only (1)
SSD (1-G061-2)	IM2 only
SFP (1-G062-2, 1-G063-2)	IM2 only

(1) Replacement option does not use free slot.

- IRIG (1-G001-2) or IRIG/GPS expansion board (1-G002-2)
- SCSI interface board (IM1 only, 1-G004-2)

The following option is a replacement of the standard communication slot:

- Fiber-optic Ethernet interface (IM1 only, 1-G050-2)

Note *The fiber-optic Ethernet and SCSI option cannot be combined in the IM1.*

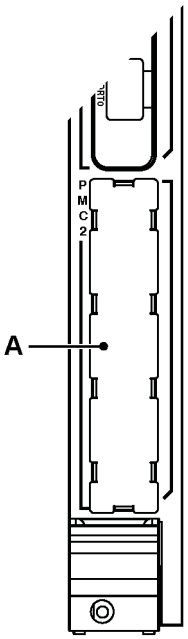


Figure 8.1: Free slot on system controller

A Free space for option

8.1.1 IRIG and IRIG/GPS expansion boards

The IRIG boards provide precise time and frequency reference to the GEN series data acquisition system. Time is acquired from either the GPS satellites using an antenna / receiver (IRIG/GPS model only) or from time code signals, typical IRIG B.

Note *Available for IM1 and IM2*

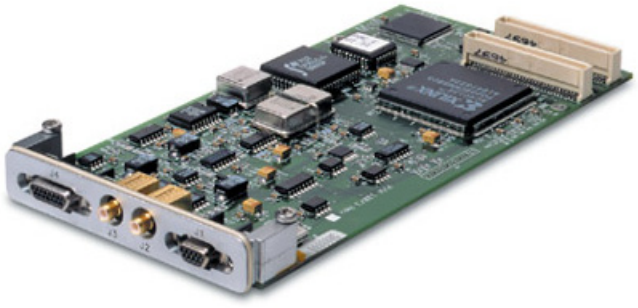


Figure 8.2: IRIG & IRIG/GPS board

IRIG/GPS			
Component	**Unit Description**		**Value**
Time code translation	Formats	IRIG A, IRIG B, AM modulated or DC level shift (DCLS)	
	Accuracy		<5 ms modulated, <1 ms (DCLS)
	Compliance	When bits are present	IEEE1344
Functions	Event capture	Start of recording	
	Oscillator	Regulates the GEN series sample rate	
	Stability	Short term Tracking	5.0 E-8
		Long term "Fly-wheeling"	5.0 E-7
Connector types	GPS	Micro DP	9-pin
	Time code in	SMB socket	
	Time code out	SMB socket (IRIG B)	
	Module I/O	Micro DP - not for external use	15-pin
GPS sub-system	Accuracy		<1 ms
	Synchronization time	Depending on coverage variables	Up to 45 min

Ordering Information		
Component	**Unit Description**	**Order number**
IRIG/GPS	GEN series IRIG/GPS interface option, fits PMC slot of GEN series interface card	1-G002-2

Note *Includes GPS Antenna/Receiver with 15 m interconnecting cable set.*

8.1.2 SCSI interface board

The SCSI option provides expansion and flexibility, allowing GEN series users to add a wide range of external hard drives for local storage of recordings.

Note *Available for the IM1 only*

Typical applications include:

- Automatic backup during critical tests
- Improvement of aggregate acquisition speed in multi-mainframe configurations

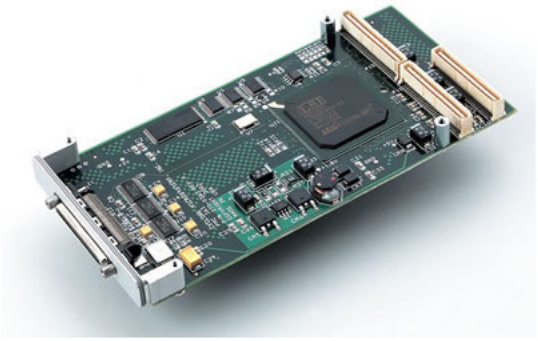


Figure 8.3: SCSI interface board

SCSI		
Component	**Unit Description**	**Value**
Type	Ultra320 SCSI	16-bit
Connector	Very High Density Cable Interconnect (VHDCI)	68-pin
Speed	To SCSI drive	8-10 MS/s (16-20 MB/s)
	To SCSI RAID drive	25-30 MS/s (50-60 MB/s)
Max number of devices	For cables up to 12 m in length	16
	For cables over 12 m	2
Termination	Low Voltage Differential (LVD) termination	
Scalability	Multiple mainframes with a single SCSI drive each	180 MB/s maximum
	Multiple mainframes with a single SCSI RAID drive each	540 MB/s maximum

Ordering Information		
Component	**Unit Description**	**Order number**
Interface	Fits the PMC slot of a GEN series interface card	1-G004-2

Ordering Information		
Component	**Unit Description**	**Order number**
External Hard Disk Drive	Needs interface option, stand alone Hard Disk Drive housing with 300 GB Hard Disk Drive; including connection cable to SCSI interface	1-G005-2
Rack Hard Disk Drive	GEN series Rack mount 300 GB SCSI Hard Disk Drive with housing; including connection cable to SCSI interface, needs SCSI interface option	1-G006-2
Rack RAID	GEN series Rack mountable SCSI RAID type ICEBOX or similar; including connection cable to SCSI interface, needs SCSI interface option. *More details on request*	on request

8.1.3 Fiber-optic Ethernet data transfer (Fast Streaming)

The GEN series Fiber-optic Ethernet option provides additional transfer speed for streaming mode acquisitions through the Ethernet connection to your PC. In typical situations transfer will be almost twice as fast compared to the standard transfer rate of 12.8 MB/s (for details see “Specifications” on page 263).

Note *Available for the IM1 only*

High Speed Ethernet			
Component	**Unit Description**		**Value**
Transfer rate	Typical	Through a 1 GB Ethernet with dedicated PC and Perception software	15 MS/s (30 MB/s)
	Maximum	Through a 1 GB Ethernet with dedicated PC and Perception software but without PC screen updates	25 MS/s (50 MB/s)

Ordering Information		
Component	**Unit Description**	**Order number**
Fast streaming	High speed Ethernet transfer, increased throughput to control PC’s HD, *included with the GEN5i*	1-G003-2

8.1.4 Fiber-Optic Ethernet Board

The GEN Series Fiber-Optic Ethernet Option is 'factory-installed-only' and replaces the standard single-channel copper wire Ethernet interface of a GEN Series interface/controller module.

Note *Available for the IM1 only*

Figure 8.4: Fiber-Optic Ethernet Board

The option provides an extra 1 Gigabit optical Ethernet link for the fastest possible communications. The use of fiber-optic links in local area networks is now common place due to the inherent advantages of using fiber. High data rates can be maintained without electromagnetic or radio frequency interference (EMI/RFI). Longer distances can be achieved over that of copper wiring. For the industrial user, fiber offers high-voltage isolation, intrinsic safety and elimination of ground loops in (geographically) large installations.

With the fiber-optic Ethernet Option you have:

- Speed: 1 Gbit per second
- Versatility: Ability to select copper or fiber
- Innovation: High speed, excellent reliability and latest technology

Auto detection

At the system start-up the option auto-detects which of the interfaces is used i.e. copper or fiber. When both interfaces are connected the fiber-optic connection has priority and will be used.

The initial selected interface remains in control as long as the system is powered. To switch to another interface you must power-down the system and start-up again with the required interface connected.

Front-Panel layout
With the option installed the front-panel of the interface/controller module has the following layout:

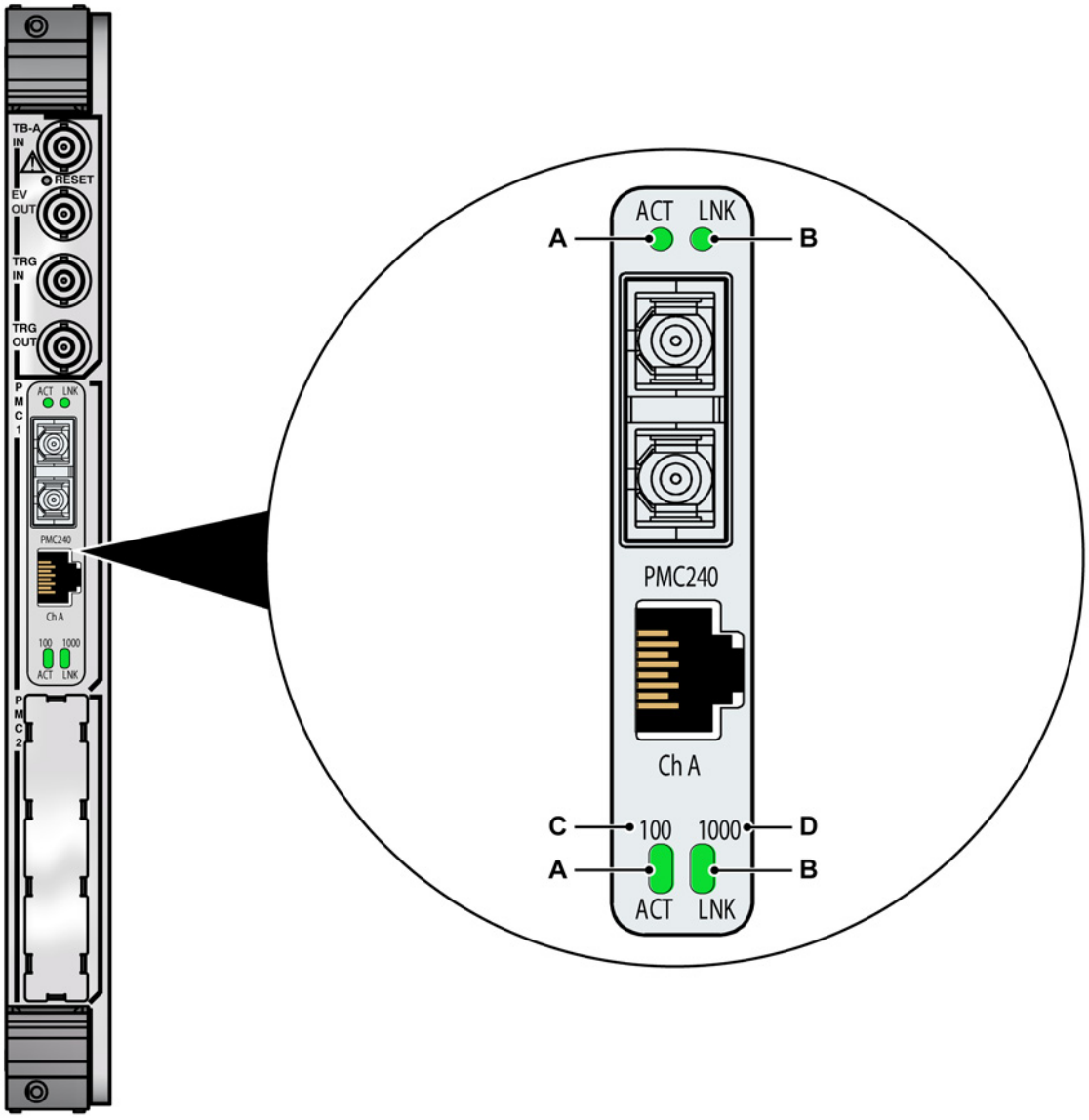


Figure 8.5: Front-Panel of the interface/controller module

A ACT: Indicates channel activity
B LNK: Indicates Ethernet link status
C 100: Indicates link speed = 100 MB/s
D 1000: Indicates link speed = 1000 MB/s (1 GB/s)

The following figure Figure 8.6 indicates the positioning of the transmit and receive plugs and orientation of the connectors and keying of the plugs. The SC-type socket is designed to support self-locking duplex SC-type male connectors. This ensures that the fiber-optic plugs are securely fastened to the sockets.

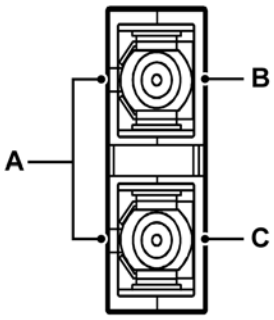


Figure 8.6: Receive (RX) - Transmit (TX) connector

A Keying

B Receive (RX)

C Transmit (TX)

Connection
Connect to the fiber-optic interface using fiber-optic cable with self-locking duplex SC-type male connectors.

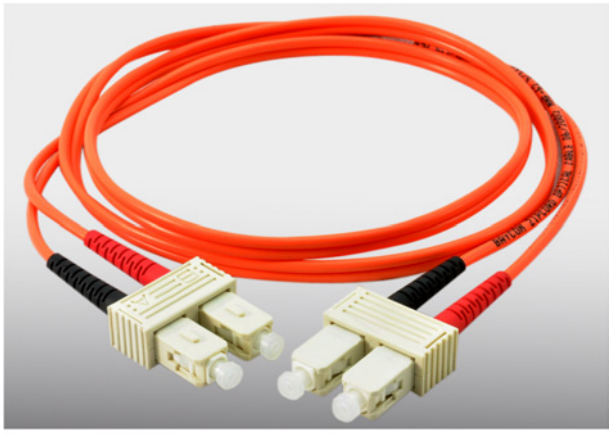


Figure 8.7: Fiber-optic cable with duplex SC-type connectors

To connect the fiber-optic interface to a network, insert the SC connector on one end of the fiber-optic cable into the interface, as shown in Figure 8.8. Ensure that the connector is inserted completely into the jack. Then insert the connector on the other end of the fiber-optic cable into the connector on an Ethernet switch, or another computer system (as appropriate).

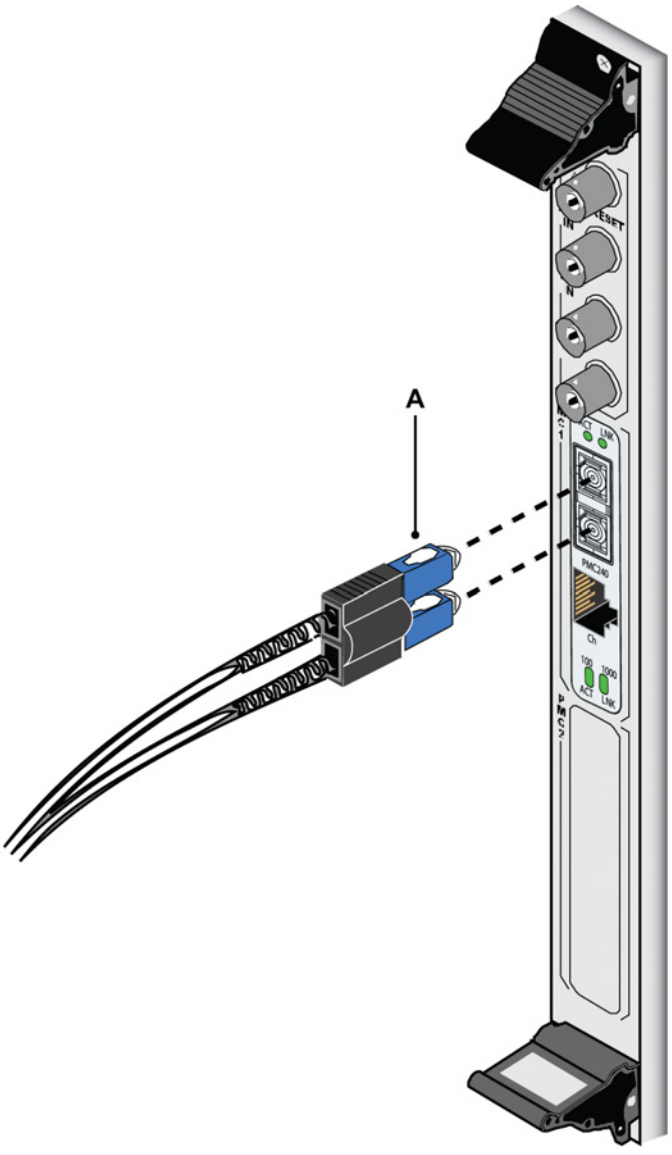


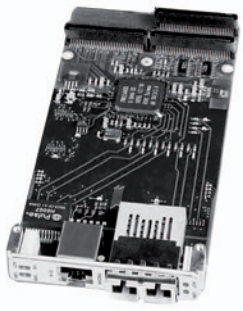
Figure 8.8: Connecting the fiber-optic cable

A SC connector

Fiber-Optic Ethernet			
Component	**Unit Description**		**Value**
Fiber-Optic Ethernet	1000 Base-SX full duplex		1 GB/s
Connectors	SC-Type connectors for dual channel fiber-optic data		1 Ch. in, 1 Ch. out
	RJ45, 8 contact, female for dual channel standard copper communication		1
Fiber-Optic	Wavelength		850 nm
	Cable type		Multimode
	Maximum cable length		500 m
Auto-Detection (1)	Auto-detects at power-on if copper or fiber connection used, the fiber connection has priority if both connections are used.		
Interface (2)	Copper	Half and full duplex with auto detection up to 100 m cable length	10 Base-T 100 Base-TX 1000 Base-T
	Fiber	Ethernet standards supported: Full duplex, up to 500 meters link length	1000 Base-SX
Indicators	Two sets of green LED's for indicating Ethernet channel operational status: ● ACT: indicates channel activity ● LNK: Indicates Ethernet link status ● 100: Indicates link speed = 100 M-bits ● 1000: Indicates link speed = 1000 M-bits (Gigabit)		

(1) At boot time GEN series will check in order the optical network first. (Reboot and unplug the Fiber-optic network to switch back to copper)

(2) It is possible to drive either the Copper or the Fiber-optic network separately but not simultaneously.

Ordering Information			
Component		**Unit Description**	**Order number**
Fiber-Optic Ethernet		A replacement for the standard Ethernet connection, a combined fiber-optical or copper Ethernet interface to a GEN7t or GEN16t mainframe. Option can only be installed at the factory.	1-G050-2

8.1.5 Solid state disk (SSD)

This is an an on-board factory installed option and needs to be ordered at the time of purchase.

Note *Available for the IM2 only*

Figure 8.9: Solid state disk (SSD)

When this option is ordered an SSD is included on board the IM2 ready to be used when you plug in the IM2 into a mainframe. The SSD is a non-removable item.

SSD Specifications		
Component	**Unit Description**	**Value**
Capacity		300 GB
Throughput	Typical speed (1)	50 MB/s

(1) Tested using a limited combination of acquisition boards.

Ordering Information		
Component	**Unit Description**	**Order number**
SSD on-board		1-G061-2

8.1.6 Fiber-optic cable

Fiber-optic cable is available for connecting and synchronizing units, there are several lengths of LC-LC duplex cables to choose from.

Ordering Information		
Component	**Unit Description**	**Order number**
KAB280	Master/Slave connection cable, Fiber-optic, LC-LC duplex, 3 m	1-KAB280-3
	Master/Slave connection cable, Fiber-optic, LC-LC duplex, 10 m	1-KAB280-10
	Master/Slave connection cable, Fiber-optic, LC-LC duplex, 20 m	1-KAB280-20
	Master/Slave connection cable, Fiber-optic, LC-LC duplex, 50 m	1-KAB280-50

8.1.7 Optical Network (SFP)

Note *Available for IM2 only*

Installation
This section covers the installation and removal of the Small Form Factor Pluggable (SFP) transceiver device.

This optional device enables an Optical Network connection direct into the front panel of the IM2.

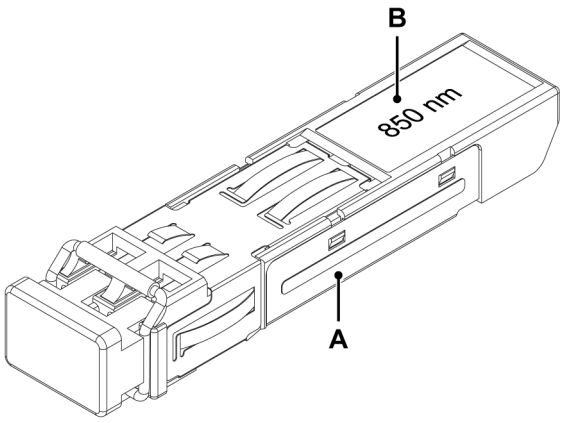


Figure 8.10: SFP Optical Network devices

A SFP shown with dust-cap and removal bar

B SFP label - 850 or 1310 nm

This is a simple and powerful plug-in-and-use option which enables the use of the Optical Network connection. There are 2 models available to choose from:

- **1310 nm (single mode)**
- **850 nm (multi mode)**

Note *This SFP slot is capable of implementing either Single Mode (SM) or Multimode (MM) optical fiber transceivers, therefore please check the correct mode of fiber-optic cable is used. Check the wavelength with the manufacturer and make sure it matches the SFP labeling.*

Warnings

Description of Electro Static Discharge (ESD)

Electrostatic discharge (ESD) can cause damage to electronic devices if discharged into the device, so you should take steps to avoid such an occurrence.

Laser Safety

The system is classified as a Class 1 laser product. The SFP uses optical light source for data and command communication . It does not emit hazardous light but it is recommended to avoid direct exposure to the beam.

Installation steps

1 First make sure the mainframe unit is switched off then locate the available SFP slot and remove the plastic plug (if inserted).

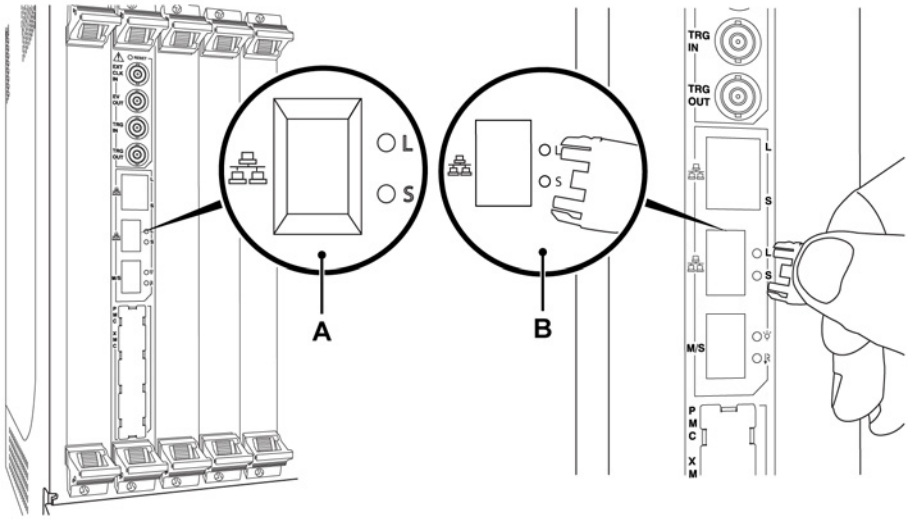


Figure 8.11: IM 2 Module Cap on/off

A IM2 Module with cap on

B Remove cap*

* In some cases you may have to remove a covering over the SFP slot. Please see explanation of how to do this in chapter "Optical Network (SFP) - Appendix" on page 227.

2 Grasp module between fingers and thumb at the end with the small black removal-bar and Insert back end into the available SFP slot, until you hear a click.

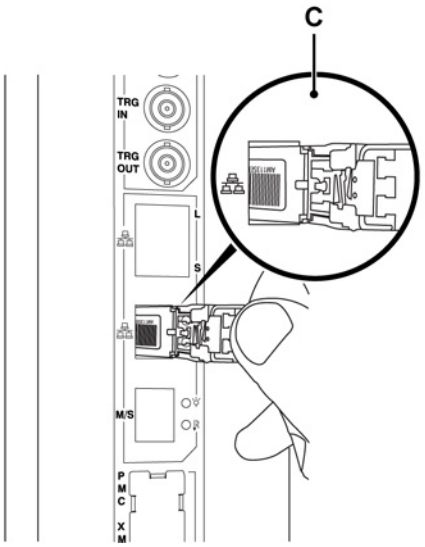


Figure 8.12: Insert device in IM2 Module

C Insert device

3 Embedded software will recognize the device and connect to it automatically when the mainframe is powered on. When there is an optical connection the RJ45 connector will be disabled.

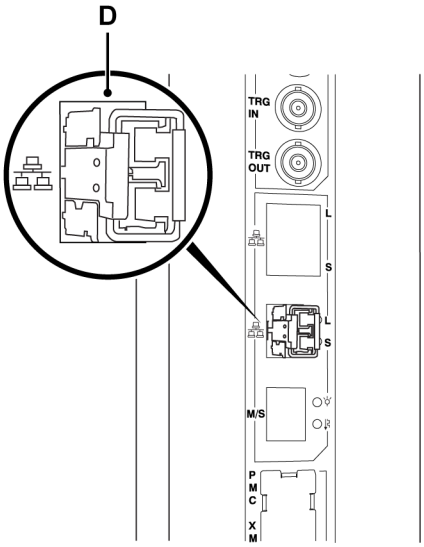


Figure 8.13: IM2 Module with device

D Device inserted

4 To remove the module from the mainframe first make sure the mainframe is powered off and then grasp the small black removal-bar and pull away and out from the mainframe. The spring loaded removal-bar will release the SFP from the front panel.

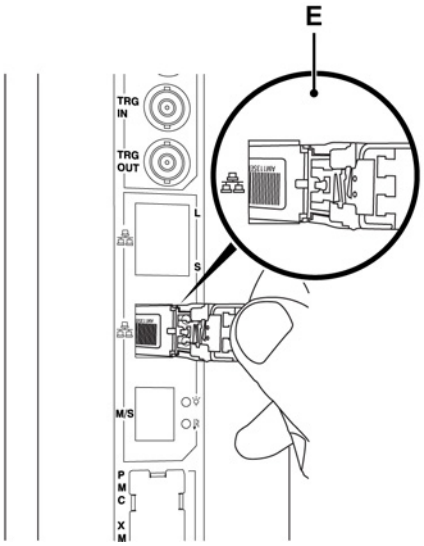


Figure 8.14: IM2 Module - Remove device

E Remove device

Then, if available replace the small plastic plug to protect the optical inlet.

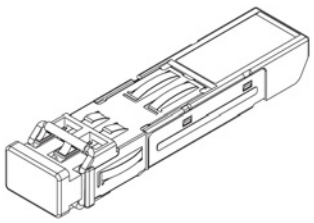
8.1.8 Optical Network (SFP) - Trouble shooting

If no connection is present on the fiber-optic channel, first check the following:

1. That the **cable type** matches the **SFP module type** (single-mode or multi-mode).
   For this you will need to check with the cable manufacturer specifications and the wavelength print on the label of the SFP module to compare (1310 nm is single-mode, 850 nm is multi-mode).
2. Check that the **cable wavelength** and **SFP module wavelength** are the same.
   For this you will need to check with the cable manufacturer specifications and check the print on the label of the SFP module to compare.
3. Check that the communication speed at either end of the fiber-optic connection is the same.
4. Inspect cable and connectors for any possible faults and breaks that could impede communication.

8.1.9 General Specifications

Optical Network (SFP) Option		
Component	**Unit Description**	**Value**
Connector	Compatible with	LC-Duplex fiber connector
Power supply		+3.3 V dc
Gigabit Ethernet	1000BASE-LX & Small Form Factor Pluggable (SFP)	1.25 Gbit
Laser frequency	Single Mode Multi Mode	1310 nm 850 nm
Link Lengths	Required mode fiber at 1.25 Gbit: 0.5 to 550 m 0.5 to 550 m 0.5 m to 10 km	 50 µm MMF 62.5 µm MMF SMF
Eye safety certified		US 21 CFR(J) IEC 60825-1 (+All)

Ordering Information			
Component		**Unit Description**	**Order number**
SM SFP		Wavelength 1310 nm	1-G062-2
MM SFP		Wavelength 850 nm	1-G063-2

8.1.10 Optical Network (SFP) - Appendix
Removing SFP protective cover on a GEN2i

1 To use the SFP option on a GEN2i with IM2 you need to remove the protective cover first.

Note *Requires screw driver Torx T10.*

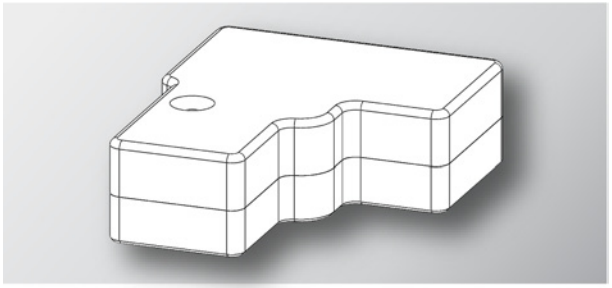


Figure 8.15: (GEN2i SFP cover - standard)

2 When removed replace with the new cap to keep the socket protected.

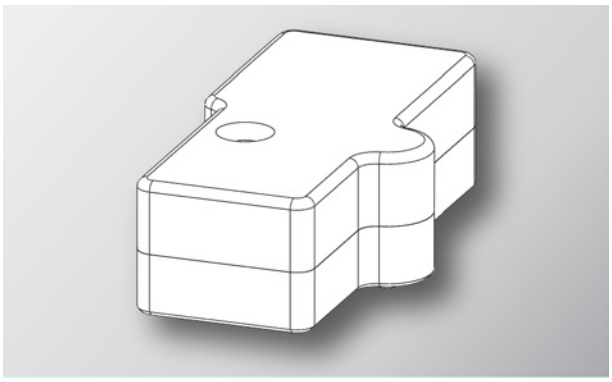


Figure 8.16: (GEN2i SFP cover - new)

Removing SFP protective cover on a GEN5i

1 To use the SFP option on a GEN5i with IM2 you need to remove the protective cover first.

Note *Requires screw driver Phillips #2.*

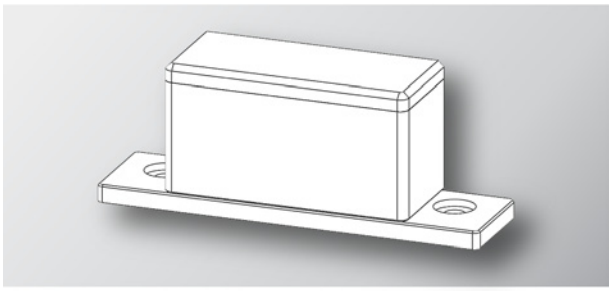


Figure 8.17: (GEN5i SFP cover - standard)

2 When removed replace with the new cap to keep the socket protected.

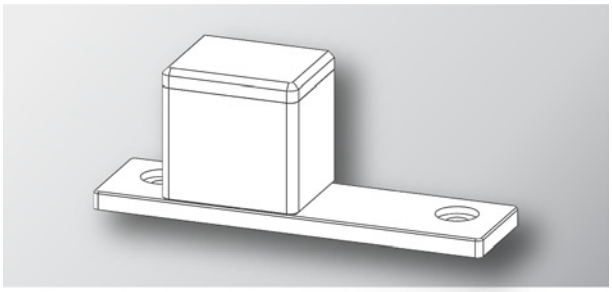


Figure 8.18: (GEN5i SFP cover - new)

9 Acquisition and Storage

9.1 Introduction

Data acquisition hardware within the GEN series is based on the concept of a **recorder**. A recorder consists of a number of acquisition **channels** that share the same basic recording parameters sample rate, sweep length and pre- and post-trigger length. Usually a single recorder is physically identical to a single acquisition card. Multiple recorders can be placed in a single **mainframe**. The mainframe is the housing for the recorders, provides the power and includes the interface for the local area network. A mainframe has its own network address (IP address). Within the Perception software recorders can be combined into logical **groups** for easy reference. Recorders within a group are not bound by physical mainframes.

For the sake of simplicity we will consider a single channel only in this section.

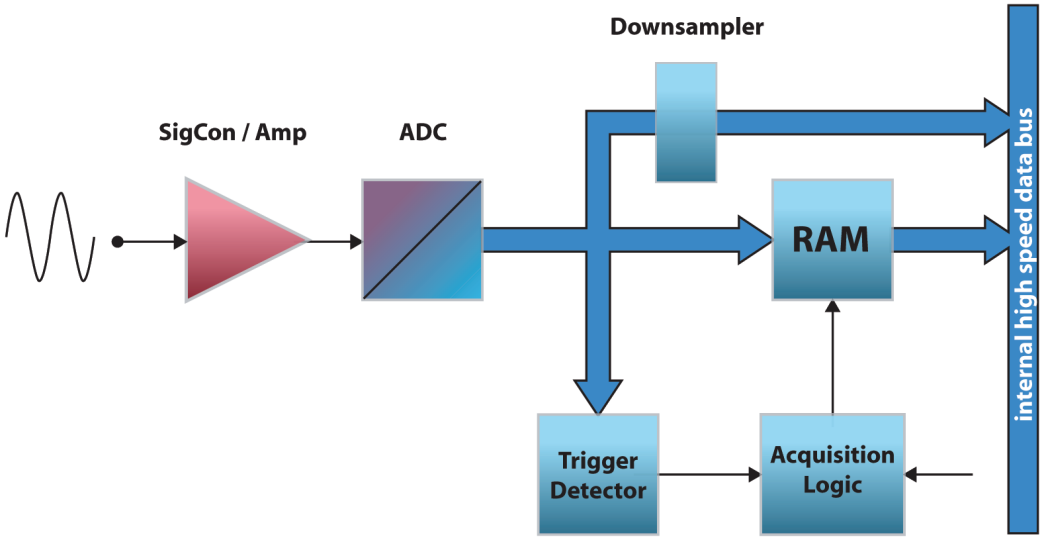


Figure 9.1: Simplified generic single channel data acquisition system

In the GEN series data acquisition system and the Perception software that goes with it a separation is made between acquisition and storage. **Acquisition** is the act of digitizing analog data and makes it available for monitoring or storage. **Storage** is the actual archiving of digitized data. **Recording** (verb) is acquisition + storage.

9.2 Acquisition

Since many of the features that are described here are controlled from within the Perception software, it is advised to read this section in combination with the corresponding sections in the Perception manual.

The GEN series/Perception combination provides the following acquisition controls:

- **RUN** The run command starts acquisition of data. Now the recorder(s) acquire(s) data until a stop command is issued. This stop command can be manually or triggered (when in sweep storage mode).
- **STOP** To stop or abort an acquisition. The current recording will be closed. When in Single-Shot acquisition mode, a stop command while acquiring post-trigger data will be processed at the end of the sweep, i.e. the sweep will be handled as specified. A second STOP command within this post-trigger interval will abort the current sweep immediately.
- **SINGLE SHOT** To start a single sweep acquisition. In this mode the recorder acquires data until a valid trigger condition is met and the post-trigger data has been recorded or when a stop command has been received.
- **PAUSE** This mode has two options:

  1 When no acquisition is active it will place the recorder in the pause or stand-by mode. Although the recorder is digitizing, no data is stored in memory or disk. This is useful for monitoring purposes.

  2 When a continuous acquisition is active, it will place the recorder in a hold mode: although the recorder is digitizing, no data is stored in memory or disk. At this point when RUN is selected, the current recording continues, when STOP is selected, the recording is finished.

These acquisition controls are combined with the various storage modes.

9.3 Storage

The GEN series provides two storage paths as shown in Figure 9.1 "Simplified generic single channel data acquisition system" on page 229:

- Store data in on-board RAM at high speed
- Transfer data directly at reduced speed to the controlling PC or (when installed) to a local hard disk.

In addition to these storage paths the GEN series provides two fundamental storage modes:

- **Sweeps:** data storage of predefined length. Sweeps typically use a trigger to define the end of the sweep.
- **Continuous:** data storage of undefined length. The end of this storage mode can be defined by various events as described later.

When data is stored, this data is organized in recordings. A recording (noun) is defined as all the data that has been stored between the start of acquisition (RUN command) and the end of acquisition. The end can be defined in various ways. A recording can have one or multiple sweeps, a continuous data stream or a combination of both.

From within Perception a recording is organized as a pNRF file.

CAUTION

The GEN series RAM is volatile. Therefore you will need to transfer the acquired sweeps to your PC for archiving.

The storage mode defines how data that is digitized and acquired is saved. The continuous storage mode will always store data, regardless of the acquisition mode. The Sweeps storage mode will store only the sweeps, regardless of the acquisition mode. However, the resulting file - or recording - will be different for the various combinations of acquisition and storage mode.

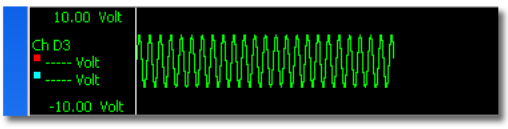


Figure 9.2: Acquisition: Run / Single Shot - Storage: Continuous

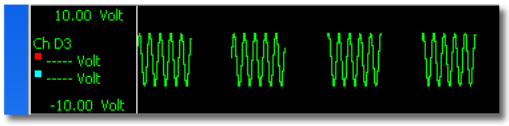


Figure 9.3: Acquisition: Run - Storage: Sweeps only

Figure 9.4: Acquisition: Single Shot - Storage: Sweeps only

The basic storage modes can be combined to create more advanced storage modes:

Dual In this mode, sweeps as well as continuous data is stored. Therefore the end result is a recording that comprises the higher speed sweeps as well as the lower speed continuous data in between the sweeps.

Slow-Fast Sweep In this mode sweeps as well as continuous data is stored. The difference with the dual mode is the fact that the continuous data stream is now actually a slower speed sweep, i.e. it has a predefined length and requires a trigger. The trigger position is the same as the trigger of the first high-speed sweep.

9.3.1 More on sweeps

Figure 9.1 "Simplified generic single channel data acquisition system" on page 229 is a very simplified block diagram of the general concept of a single channel digitizer. Once the analog values have been converted by the ADC into binary codes, they are stored in successive order in a buffer memory, the on-board RAM. This memory can be divided into multiple segments to allow for the storage of multiple sweeps.

If the last storage location of a segment is filled and acquisition is still taking place, the first storage location is overwritten with a new sample, followed by the second storage location, etc.

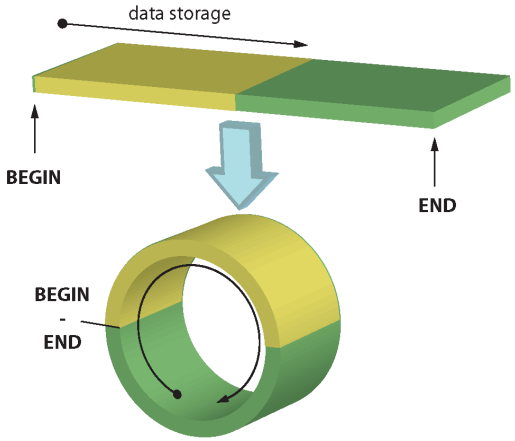


Figure 9.5: Ring buffer operation of memory

The physical memory therefore forms a ring buffer, into which information can be continuously added (Figure 8-5). This process of filling the ring buffer memory terminates only when the recording logic indicates that the recording must be ended. Once the recording has stopped, the content of the buffer memory becomes available to the control PC for processing. This is also called **circular recording**.

Pre-trigger sweeps

As we have seen, data emerging from the ADC is stored in the buffer memory. When recording, the memory is continuously refreshed with new sample values, until storage is halted. The information available in the memory is a **history** of the recorded signal up to the moment of 'end-of-recording'. The extent of this history depends on the sample rate and the data storage capacity (length) of the memory. If we assume a memory length of 40 000 samples and a sample rate of 10 000 samples per second, then the time window of the history will be:

(EQ 1)

$$t_{window} = \frac{40000}{10000} = 4 \text{ seconds}$$

Storage into the ring buffer can be stopped only by a 'stop' signal from the recorder. This signal is called the "trigger". For full details on triggering see “Digital Trigger Modes” on page 241.

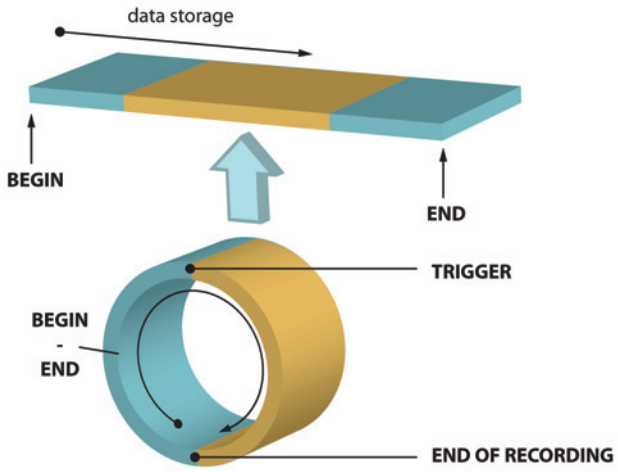


Figure 9.6: Ring buffer with trigger and end-of-recording

Since the trigger stops the storage, all stored information is termed pre-trigger information. When storage stops because the acquired signal has met a trigger condition, only pre-trigger information is available - information recorded before the signal met the trigger condition.

Figure 9.7: Full pre-trigger storage: pre-trigger = 100%

More often one is interested in what happened just before and after the condition was met. To achieve this aim, a delay is introduced. Once the trigger condition is met, storage is stopped - not immediately, but only after a programmable delay counter has counted out. The memory now contains pre-trigger information and post-trigger information.

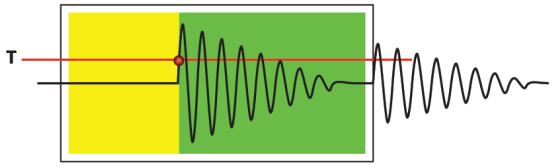


Figure 9.8: Pre-trigger / post-trigger storage: 0% < pre-trigger < 100%

The usage of a variable delay counter allows for a user-definable pre-trigger length. The length of the pre-trigger segment equals the length of the memory segment minus the delay. When the length of the delay is equal to, or exceeds, the length of the memory segment, only post-trigger information is available.

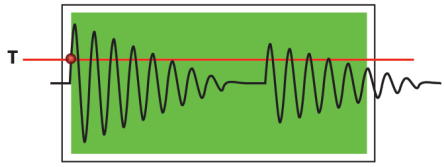


Figure 9.9: Full post-trigger storage: pre-trigger = 0%

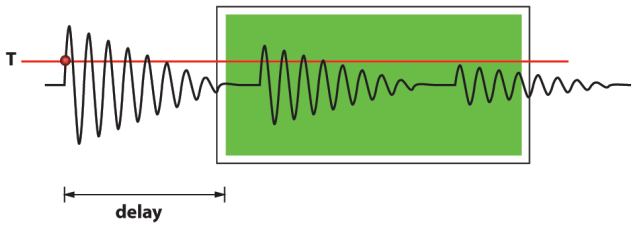


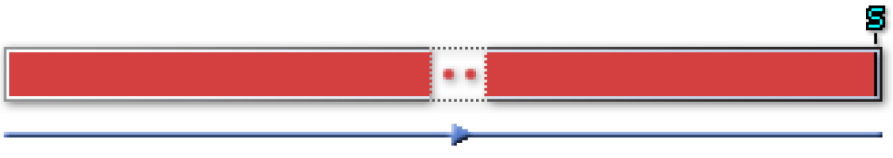
Figure 9.10: Delayed trigger storage: pre-trigger < 0%

9.3.2 More on continuous data storage

The most important difference between continuous data storage and sweeps in a GEN series is the fact that sweeps are stored in on-board volatile RAM, while continuous storage takes place on the controlling PC's hard disk (or local hard disk when installed).

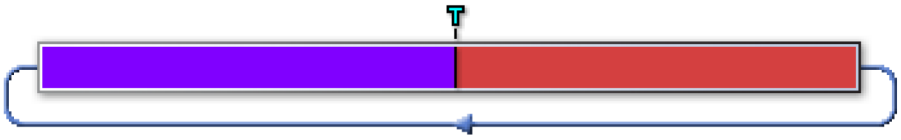
The continuous data storage provides three modes:

- **Standard** The continuous mode is standard when storage is started and stopped manually as depicted below (graphic taken from Perception software):



- **Circular** The continuous mode is circular when storage is started and stopped manually AND the length of the buffer is defined. Operation is now equal to standard sweep storage, but on PC hard disk and not in volatile memory. In this mode the **lead-out** is specified which is basically the same as the post-trigger segment in a sweep recording.

- **Stop on trigger** The continuous mode now operates like a pre-trigger sweep, but on PC hard disk and not in volatile memory.



9.4 Timebase

The power of modern data acquisition techniques is achieved by *digitizing* analog information. Digitizing is the conversion of the instantaneous value of an analog signal (static or dynamic) into a numeric value. When the signal varies, *sampling* the instantaneous amplitude at sufficiently rapid intervals converts this signal into a series of numbers that can represent the original analog signal.

9.4.1 Real-time sampling and timebase

Real-time sampling is a straightforward sampling method and is the only method to record non-periodical phenomena. In this method, the intervals between the samples taken of the original signal are as short as possible and equidistant. If the sample rate used is high enough, the original signal can be reconstructed without any additional processing.

The sample rate is determined by the timebase: the timebase is a clock that generates pulses used to drive the A-to-D Convertor. Within the GEN series you have the following timebase options:

- **Internal timebase** When you select the internal timebase, the clock used to drive the ADC's is the built-in clock.
- **External timebase** When you select the external timebase, the clock used to drive the ADC's is the clock signal presented at the external clock input BNC on the GEN series Controller/Interface module. When you select this mode, the interval between two consecutive samples may not be equidistant. This all depends on the accuracy of the supplied clock signal. For more details see "I/O connectors (IM1)" on page 197 and "I/O connectors (IM2)" on page 203.

The above selection is made in the Perception software in the Settings Sheet ► Recorder ► Timebase Source.

When internal timebase is selected there are two related options:

- **Internal Clock Base Decimal** This setting is used to create timebase values that are base 10, e.g. 1 MHz, 100 kHz, 50 kHz, 2.5 Hz, etc. These values are derived from a main oscillator that operates at a base 10 frequency, e.g. 1 MHz.
- **Internal Clock Base Binary** This setting is used to create timebase values that are base 2, e.g. 1.024 MHz, 512 kHz, 64 Hz, etc. These values are derived from a main oscillator that operates at a base 2 frequency, e.g. 1.024 MHz.

The above selection is made in the Perception software in the Settings Sheet ► Mainframe ► Internal Clock Base and is therefore mainframe-wide, i.e. the same for all recorders.

A binary clock base is a useful timebase settings when doing FFT's (frequency domain analysis).

9.4.2 Timebase settings for FFT's

When doing FFT's there are two topics that affect the acquisition:

1. It makes life easier when the final FFT yields spectral lines with a distance Δ **f** that is a "nice" value. Otherwise stated: the FFT bin size should preferably be a nice value. Sometimes this is also called the "frequency resolution". The bin size is determined by the actual acquisition length or sweep length: **bin size = 1 / T** in which T is the total recording time. E.g. a one-second sweep will result in a 1 Hz bin size, a 0.5 second sweep results in a 2 Hz bin size.
2. Preferably the acquisition length is equal to a power of two. Fundamentally most FFT algorithms work on data sets with a length of 2^N.

The binary clock base of the internal timebase in combination with the division factors allow for a broad range of values that meet both requirements. In the table below various sample rates are given as well as the corresponding division factor (divisor). The table shows the bin sizes that result from these sample rates in combination with various sweep lengths.

Example: from the table you can read that a sample rate of 40.960 kHz and a sweep length of 8192 samples result in a 5 Hz bin size, i.e. the spectral lines are 5 Hz from each other.

"Nice" values are considered to be "minor" values that easily fit in "major" values for (grid) display purposes.

In the table below the values are in the colored cells and basically comprise the range 1.25, 2.5, 5, 10, 20.

Table 9.1: Examples of FFT Bin sizes

TIMEBASE MAIN = 1.024 MHZ		FFT SIZE (SWEEP LENGTHS)					
		256	512	1024	2048	4096	8192
SMP/S	DIVI-SOR	FFT BIN SIZE IN HZ					
1024000	1	4000	2000	1000	500	250	125
512000	2	2000	1000	500	250	125	62.5
256000	4	1000	500	250	125	62.5	31.25
204800	5	800	400	200	100	50	25
128000	8	500	250	125	62.5	31.25	15.625
102400	10	400	200	100	50	25	12.5
51200	20	200	100	50	25	12.5	6.25
40960	25	160	80	40	20	10	5
25600	40	100	50	25	12.5	6.25	3.125
20480	50	80	40	20	10	5	2.5
12800	80	50	25	12.5	6.25	3.125	1.5625
1024	100	40	20	10	5	2.5	1.25
5120	200	20	10	5	2.5	1.25	0.625
4096	250	16	8	4	2	1	0.5
2560	400	10	5	2.5	1.25	0.625	0.3125
2048	500	8	4	2	1	0.5	0.25
1280	800	5	2.5	1.25	0.625	0.3125	0.0156
1024	1000	4	2	1	0.5	0.25	0.125

Additional information

The Nyquist frequency (f/2) is the maximum frequency that can be accurately measured by a digitizer sampling at a rate of (f). Otherwise stated: a digitizer sampling at a rate of (f) cannot measure an input signal with bandwidth components exceeding f/2 without experiencing "aliasing" inaccuracies.

Nyquist's theorem determines the range of frequencies that can be measured. They range from DC to one half the sampling rate at which the data was captured. An FFT of a sweep of N points produces N/2 frequency domain data points within the range of frequencies between DC and the Nyquist frequency. So the frequency resolution is:

(EQ 2)

$$\Delta \mathrm{f} = \frac{samplerate\ /\ 2}{N\ /\ 2}$$

As an example assume a sweep of 8192 points (N=8192) and a sample rate of 40.96 kHz. This will yield the following:

- Frequency resolution Δf = (½ * 40960) / (½ * 8192) = 5 Hz
- Number of frequency domain points: N/2 = 4096
- The minimum frequency component that can be measured is equal to the frequency resolution Δf = 5 Hz
- The maximum frequency component that can be measured is 40.96 kHz / 2 = 20.48 kHz

The FFT X-scale (frequency) will start at 5 Hz, end at 20480 Hz, and has 4096 points.

10 Digital Trigger Modes

10.1 Introduction

Within the GEN series data acquisition system, each and every channel is equipped with a **trigger detector**, which makes it possible to record just the phenomenon of interest, instead of having to search the full memory to find it. The trigger detector gives the system the power to capture elusive, short and unpredictable events. It determines how easily you can extract the event of interest.

The word **trigger** has a dual meaning in recording techniques. In the active sense, the instrument has triggered, indicating that the instrument has responded to a certain stimulus. In the passive sense, as in trigger point, it indicates the point (in time) where the instrument has triggered. In both cases, trigger refers to a known, pre-defined situation.

The trigger can be generated in several ways:

- by the user, i.e. **manually**
- using an externally applied signal, i.e. **external** trigger
- when the acquired **signal** complies with a certain condition: the trigger condition. Each channel within a recorder can trigger this recorder.

For transient recording this last option is of great importance. The trigger facilities determine to a large extent the application capabilities of the data acquisition system - i.e. how effectively the data can be captured.

In this chapter the trigger capabilities of the GEN series data acquisition system will be explained in full detail.

Each channel within a recorder can trigger this recorder. This functionality is realized by combining all channel triggers into a logical OR combination: When one of the channels (or multiple channels) generates a trigger, the complete recorder triggers. Each channel's trigger detector can be switched off or set into one of the modes described in this chapter.

10.2 Understanding digital triggering

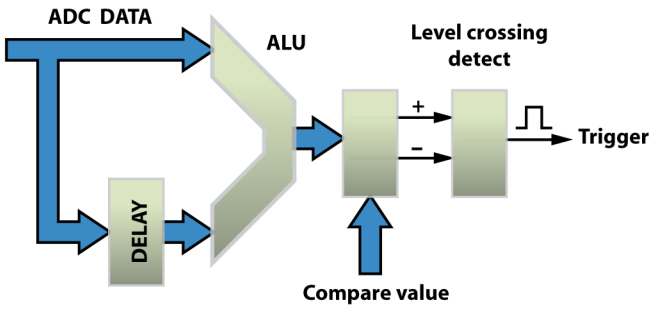
Technically speaking, there are two approaches to determine the known, pre-defined situation of the signal: analog or digital.

Each channel in the GEN series system is equipped with a digital trigger detector, because it has stable vertical reference levels, because it does not encounter horizontal jitter, and because it is frequency independent.

A disadvantage of a digital trigger detector is its inability to detect events between two consecutive samples. This does not usually interfere with normal operation because the event is not recorded anyway.

10.2.1 Digital trigger detector

Figure B-2 shows a simplified diagram of a **single-level** digital trigger detector. Digitized values coming from the ADC are fed into an Arithmetic (and) Logic Unit – ALU. The value that comes out of the ALU is then referenced against a preset value (trigger level). The result can be either positive, i.e. the value is larger, or negative, i.e. the value is smaller. Based on this information the level crossing detector verifies if a level crossing in the correct direction has occurred and if so, sends out a trigger.



The delay register in front of the ALU is used to compare the ADC value with “older” values. This means that triggering is not reacting to specific levels, but to the differential signal or **slope**.

As explained later in this chapter, a signal must actually cross the preset level. This is to avoid erroneous triggering on a small amount of noise on the signal. To make the trigger detector even more stable when noisy signals are used, the single-level trigger detector has been expanded with a **hysteresis**. This basically doubles the logic.
For the advanced trigger modes the single-level trigger detector with programmable hysteresis has been implemented twice to provide a **dual-level** trigger detector with selectable hysteresis on each channel. Levels are usually referenced as *primary* trigger level and *secondary* trigger level.

10.2.2 Valid trigger conditions

Trigger detection is based on level crossing: A signal has to cross a specified level to be considered a trigger condition. As a consequence, reaching the required level is not a valid trigger condition. Since trigger detection is digital, inter-sample analog values are omitted.

In the following graphs these conditions are shown.

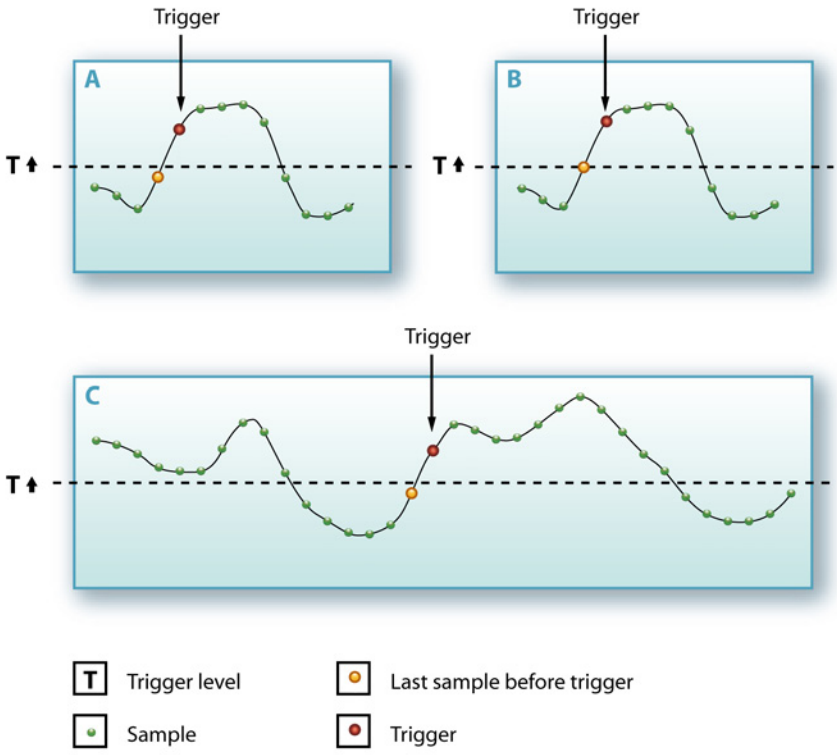


Figure 10.1: Level crossing detector

As trigger mode basic trigger is shown with a specified level (**T**), and a level crossing in positive direction. In Figure 9-3A the trigger occurs on the first sample after the level crossing. Figure 9-3B shows the situation in which a sample equals the set level. Trigger does not occur until a sample is actually above the required level.

Since the trigger detector requires a level crossing, no trigger occurs when a signal is above the set level when recording starts. This is depicted in Figure 9-3C.

Figure 10.2 shows the influence of the additional hysteresis. Fundamentally all is the same as described earlier. The only difference now is that a second level (H) is used to 'arm' the level trigger detector. Otherwise stated, the trigger level has been expanded to be a trigger zone that spans multiple levels.

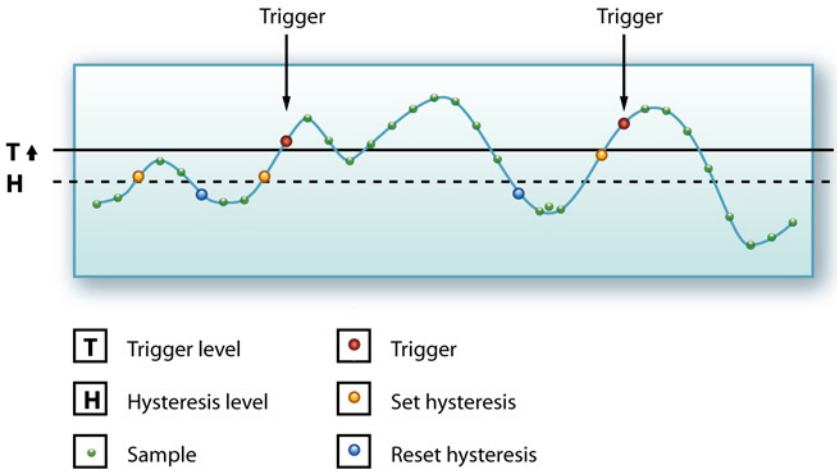


Figure 10.2: Trigger level hysteresis

10.3 Trigger modes

Using the various trigger modes, your GEN series data acquisition system is expanded to an extremely versatile transient recorder. The trigger circuits may be configured to trigger on many types of phenomena. In this section the different trigger modes and their extensions are discussed in detail.

10.3.1 Basic trigger mode

The basic trigger mode can be compared with the trigger mode available when using an analog trigger detector, for example as found on a classic scope.

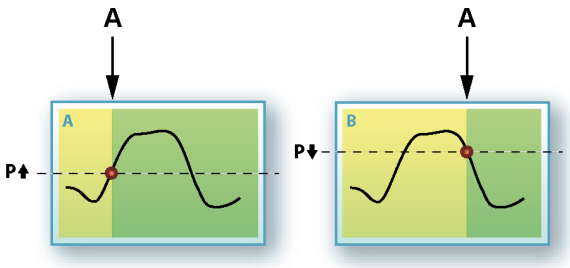


Figure 10.3: Basic trigger mode

A Trigger

In this mode a single-level trigger detector is active: the primary level. As mentioned previously, the signal must actually cross the preset level. Both level and direction of crossing are selectable.

Relevant settings for this mode:

- Mode: Basic
- Primary level: any value within the input range
- Direction: positive or negative
- Hysteresis: any relevant value

10.3.2 Dual trigger mode

In dual trigger mode two detectors are active and working in parallel: the primary level **P** and the secondary level **S**. With two levels it is possible to define a range the input signal must be within. As soon as the signal becomes larger than the upper level, or smaller than the lower level, the detector will generate a trigger. By inverting the slopes of both detectors, the trigger will be generated when the signal returns into the specified range.

Figure 10.4 shows the various possibilities.

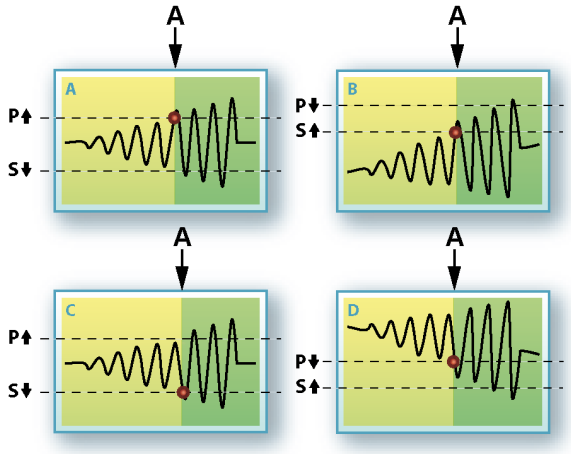


Figure 10.4: Dual trigger mode

A Trigger

You can select any value for each level and the slope of the primary level. The slope of the secondary level is automatically set to the opposite direction.

Diagrams A and C show a signal that exits the range, diagrams B and D show signals that enter the range.

Relevant settings for this mode:

- Mode: Dual
- Primary level: any value within the input range
- Secondary level: any value within the input range
- Direction: positive or negative for primary level, secondary level is automatically set to the opposite
- Hysteresis: any relevant value is used for both levels.

10.3.3 Window trigger mode

For the window trigger mode both levels are used. One of them has a dual function: arm and trigger, the other is used as a disarm level. To generate a trigger, the trigger detector must be armed. This is done by crossing the arm/ trigger level in the opposite direction. Once armed, the trigger is generated by crossing the arm/trigger level in the set direction, unless a crossing of the disarm level has occurred after the arm condition.

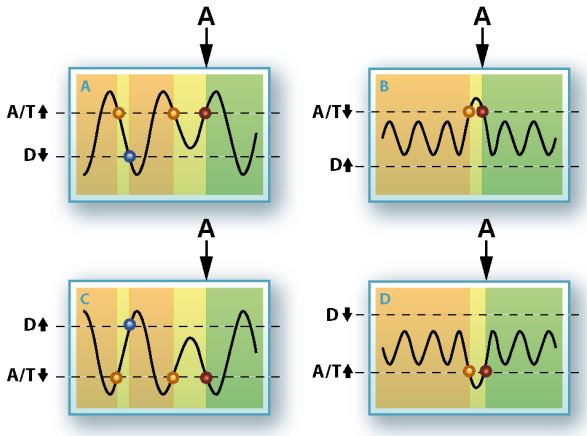


Figure 10.5: Window trigger mode

A Trigger

Diagrams A and C show the intended use of the window trigger mode: detecting a dip in a repetitive signal. Diagrams B and D show alternatives: detecting a peak pulse in a repetitive signal.

The Window trigger mode is very useful if a periodic signal is monitored and the GEN series must be triggered on peak level changes. This mode is most effective on uni-polar signals, e.g. a TTL level pulse train. For bi-polar signals the dual-window trigger mode is more suited as described in the following section.

Relevant settings for this mode:

- Mode: Window
- Primary level: any value within the input range
- Secondary level: any value within the input range
- Direction: positive or negative for primary level, secondary level is automatically set to the opposite
- Hysteresis: any relevant value is used for both levels.

10.3.4 Dual-window trigger mode

The dual-window trigger mode is a more sophisticated version of the window trigger mode. Now both levels are used as an arm/trigger/disarm level. This allows the trigger detector to react on a dip in both directions.

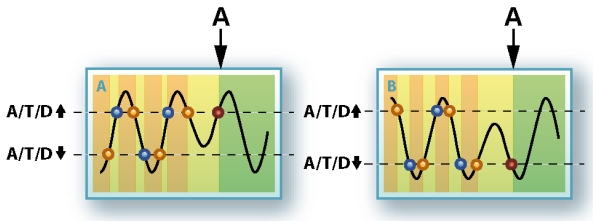


Figure 10.6: Dual-window trigger mode

A Trigger

Diagram A shows one situation, diagram B the other situation with the same settings. Here the following conditions determine the trigger result:

- Level crossing in opposite set direction = arm level
- Level crossing in set direction = disarm when other level is armed
- Level crossing in set direction = trigger when level is armed

Since this is true for both levels, a “dip” in both directions is detected as shown in diagram A and B.

Relevant settings for this mode:

- Mode: Dual-window
- Primary level: any value within the input range
- Secondary level: any value within the input range
- Direction: positive or negative for primary level, secondary level is automatically set to the opposite
- Hysteresis: any relevant value is used for both levels.

10.3.5 Sequential trigger mode

The two level comparators are set in a sequence in this mode. One is used to arm the trigger detector while the other is used to actually generate the trigger: if the incoming signal crosses the level of the first comparator, the second is activated (armed).

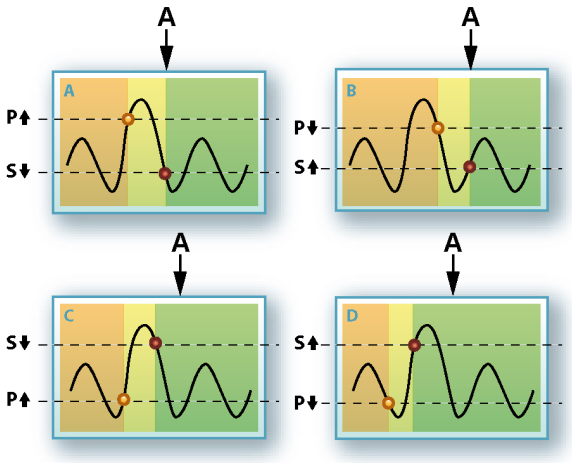


Figure 10.7: Sequential trigger mode

A Trigger

This mode can be used to help eliminate false triggering due to noise or hysteresis. The concept is sometimes also referred to as sensitivity window.

Although not very common, you can also set the level of the primary detector to a lower value than the secondary detector. This will give you the options shown in diagrams C and D.

Relevant settings for this mode:

- Mode: Sequential
- Primary level: any value within the input range
- Secondary level: any value within the input range
- Direction: positive or negative for primary level, secondary level is automatically set to the opposite
- Hysteresis: any relevant value is used for both levels.

10.3.6 Trigger qualifier

The trigger detectors of a channel can also be used as a qualifier. A trigger qualifier is a situation that enables (arms) the recorder trigger features. The recorder trigger features are a combination of various channel, external, between-recorders and other trigger options.

There are two qualifier modes:

- Basic single-level qualifier. For details see "Basic trigger mode" on page 246.
- Dual-level qualifier. For details see "Dual trigger mode" on page 247.

When in qualifier mode, the output of the trigger detector is sent to a qualifier line of the recorder trigger logic. For a full description of the recorder trigger features see "Recorder and system trigger" on page 260.

10.4 Trigger add-ons

The mentioned trigger modes can be combined with a variety of extra features, allowing to trigger on almost any signal.

Some of these extras are used to fine-tune the selected trigger mode, other features expand the capabilities of the basic trigger detector.

The following simplified diagram is from the settings sheet and shows the building blocks that make the complete channel trigger logic.

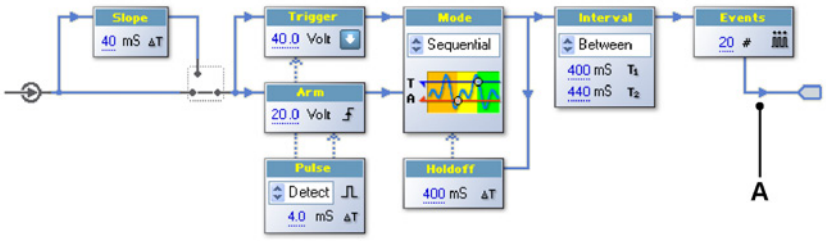


Figure 10.8: Channel trigger logic

A To recorder trigger

From left to right the following add-ons are available:

- **Slope** detector: allows to trigger on a slope instead of level
- **Pulse** qualifier: detects or rejects trigger conditions that meet a specific time frame
- **Holdoff:** disables the trigger detector for a set period of time after a trigger condition
- **Interval:** defines a time interval between two consecutive trigger conditions
- **Events:** counts the number of trigger conditions before an actual trigger is generated

10.4.1 Slope detector

All trigger functions described so far work on the absolute level of the incoming signal. The slope detector allows the same functions to work on the *difference* between a number of samples. This means that the triggering is not reacting to specific levels but to the differentiated signal or slope. The slope detector is also known as differentiator or dY/dt detector. Within the GEN series ‘dt’ is variable (delta time window) and can be set between 1 and 1023 samples, e.g. between 1 µs and 1.023 milliseconds when sampling at 1 MS/s.

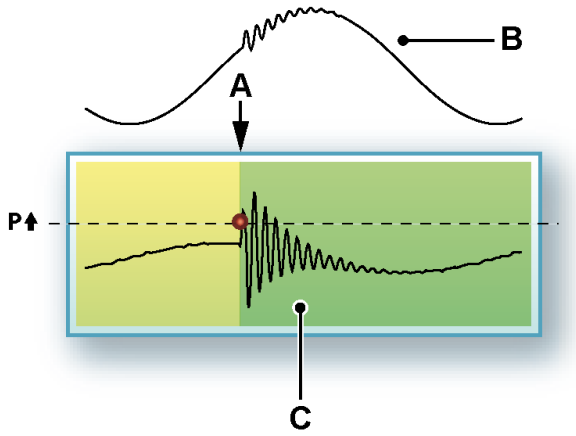


Figure 10.9: Slope trigger

A Trigger

B Original signal

C Differentiated signal

With the slope triggering it is possible to trigger on a specific change in slope of the signal, for example on a spike on a repetitive signal: if the slope (or frequency) of the signal exceeds the specified level, a trigger will be generated.

10.4.2 Pulse detector

The pulse detector can be used together with the basic (slope) trigger level detector. It can be used for two opposite purposes:

- Detect trigger conditions smaller than a set period of time: **pulse detect**
- Detect trigger conditions larger than a set period of time: **pulse reject**

All operations of the trigger detector are the result of crossing the level of a comparator. If, after crossing, the condition of the comparator is not stable for at least a specified period of time, the crossing is not a valid trigger condition, i.e. it is a small pulse (or noise) that can be omitted, and no trigger is generated.

If, after crossing, the condition of the comparator is stable for a specified period of time, the crossing is a valid trigger condition, i.e. it is a small pulse that must be recorded, and a trigger is generated.

The pulse detector operates on samples (2 to 65535). In the Perception software this is translated into time. At 1 MS/s sample rate this results in a maximum of 65.535 millisecond.

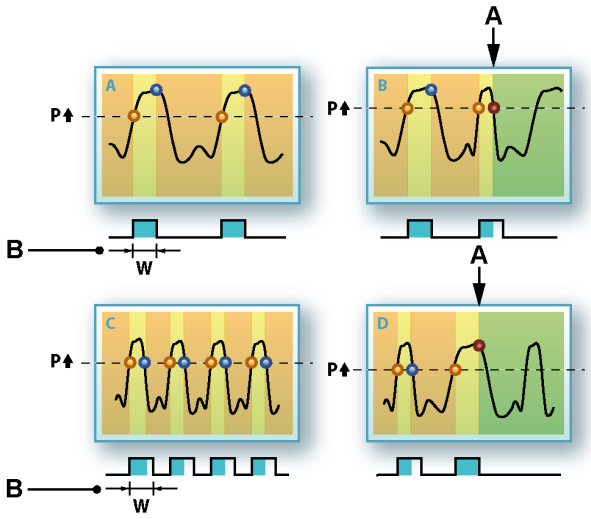


Figure 10.10: Pulse detector

A Trigger

B Width

Figure 9-12: In diagrams A and B the pulse detection is depicted. In diagram A, when the trigger level is crossed, the signal remains above the trigger level for a time interval larger than pulse width W. In diagram B there is a situation in which the signal returns through the trigger level within pulse width W. A trigger is generated on a “small” pulse.

In diagrams C and D the opposite situation is depicted: pulse reject. Now “small” pulses are not recognized as trigger condition, while a wider pulse generates a trigger.

The pulse detector can be used for both trigger levels. Combined with a hysteresis setting, the pulse detector is less sensitive to noise on the signal.

10.4.3 Holdoff

The trigger holdoff feature is used to disable the trigger detector for a period of time after a trigger condition was met.

This can be used to generate only one trigger on a slowly decaying repetitive signal, or eliminate the effect of after-ringing. Using a 16-bit counter triggering can be disabled for as long as 6.5535 seconds when sampling at 10 kS/s.

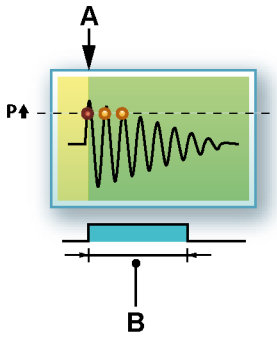


Figure 10.11: Trigger holdoff

A Trigger

B Holdoff

The feature is most useful in combination with the interval timer and/or the event counter.

10.4.4 Interval timer

A highly sophisticated trigger add-on is the interval timer. The interval timer is used to define a time relation between two trigger events. When the time relation is correct, a trigger is generated.

The following relations are possible:

- **Less:** The time interval between two consecutive trigger events is less than the specified time interval.
- **More:** The time interval between two consecutive trigger events is more than the specified time interval.
- **Between:** The time of the second trigger event is within a specified time interval that starts a specified time after the first trigger event.
- **NotBetween:** The time of the second trigger event is not within a specified time interval that starts a specified time after the first trigger event.

The interval timer operates on samples (2 to 65535). In the Perception software this is translated into time. At 1 MS/s sample rate this results in a maximum of 65.535 millisecond.

Interval timer - Less

This interval time mode is fairly straight forward. When the second trigger event is within the set time interval, a trigger is generated.

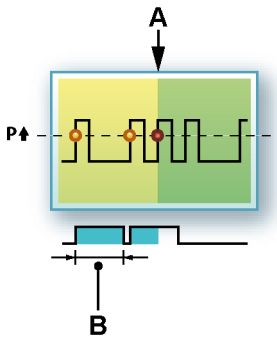


Figure 10.12: Interval timer - Less

A Trigger

B Interval

The time interval is reset on the first new trigger event. This feature allows you to detect additional pulses in a standard train of pulses for example.

Interval timer - More
This interval timer mode is more complicated. When the second trigger event is within the set time interval, no trigger is generated and the time interval is reset on each trigger event. When a new trigger event occurs after the specified time interval, i.e. the interval is not reset in time, then a trigger is generated at the end of the specified time interval.

In the reset moments are denoted with a dotted line, the actual trigger moment with a straight line.

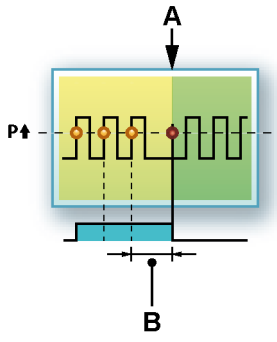


Figure 10.13: Interval timer - More

A Trigger

B Interval

This function allows you to detect a “missing” pulse in a standard pulse train for example.

Interval timer - Between
For the Between mode basically two timers are used: one to set the start of a time window and a second to set the width of the time window. The second trigger event must be within this time window.

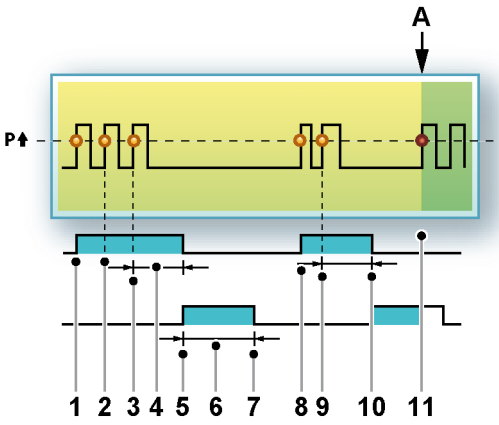


Figure 10.14: Interval timer - Between

The following sequence explains what happens:

1 The first trigger event starts interval timer 1.
2 A second trigger event occurs before interval timer 1 has expired, the timer is reset.
3 A third trigger event occurs before interval timer 1 has expired, the timer is reset.
4 Interval 1
5 Interval timer 1 expires and interval timer 2 is started.
6 Interval 2
7 Interval timer 2 expires while no trigger event occurred within the set period. The complete trigger logic is reset.
8 The first new trigger event starts interval timer 1.
9 A second trigger event occurs before interval timer 1 has expired, the timer is reset.
10 Interval timer 1 expires and interval timer 2 is started.
11 A trigger event occurs before interval timer 2 expires: a trigger is generated.

A Trigger

The first interval timer can be compared to the trigger holdoff feature described earlier. The second interval timer defines a period in which a trigger event must occur. If not, it is not a related trigger event.

Interval timer - NotBetween
The inverse function of the Between mode of the interval timer is the NotBetween mode. Now the second interval is not used to define a trigger-safe area, but to denote a trigger-restricted area. A trigger event within the first interval is valid. A trigger event within the second interval resets the trigger logic. A trigger is also generated when both interval timers expire.

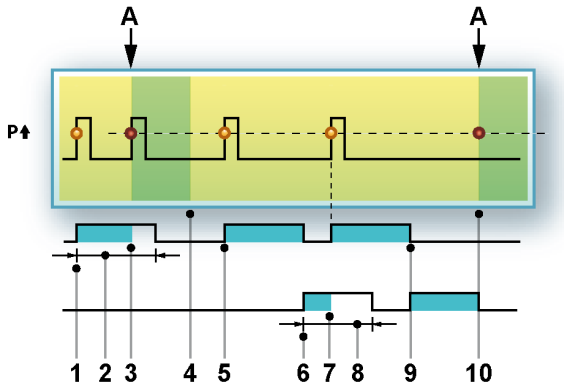


Figure 10.15: Interval timer - NotBetween

The following sequence explains how this mode functions:

1 The first trigger event starts interval timer 1.
2 Interval 1
3 If a trigger event occurs within the first interval, a trigger is generated.
4 End of sweep.
5 The first new trigger event starts interval timer 1.
6 Interval timer 1 expires and interval timer 2 is started.
7 A trigger event occurs within the second interval. Interval timer 1 is restarted.
8 Interval 2
9 Interval timer 1 expires and interval timer 2 is started.
10 Interval timer 2 expires and a trigger is generated.
A Trigger

10.4.5 Event counter

Sometimes it is not possible to trigger on a specified condition using a selected trigger mode alone, because several events meet the required situation. So far we have seen “filters” that can be used to narrow the range of trigger candidates, like holdoff and interval timer.

As a last resource the event counter can be used. The event counter adds all generated triggers and generates a final trigger when the count equals a preset value ranging typically from 1 to 256.

10.5 Recorder and system trigger

The trigger modes and features described so far are channel-based. Each analog channel within a GEN series system has a digital trigger detector. The trigger signals of all channels of a single recorder are combined through a logical OR to generate a combined trigger. This trigger can be combined with an external trigger and qualifiers. The final result is a recorder trigger. The triggers that are generated by individual recorders can be distributed to other recorders and mainframes.

The following simplified diagram is from the Perception software and shows the building blocks that make the complete recorder trigger logic. Please note that - depending on your exact hardware - not all features may be available.

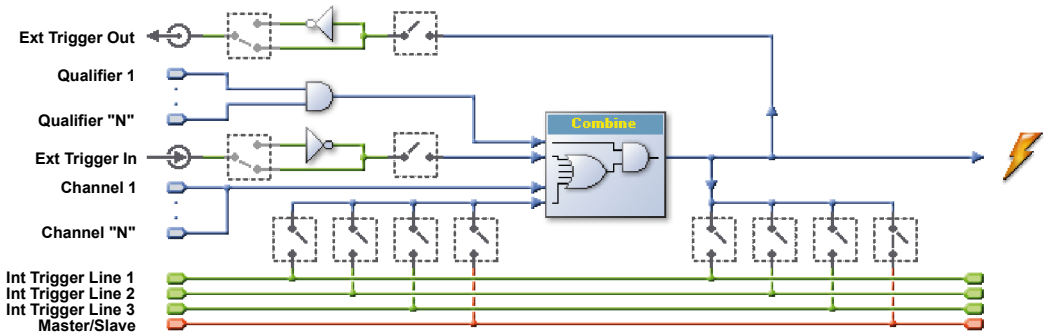


Figure 10.16: Recorder trigger logic

The heart of the recorder trigger logic is the “Combine” block. Here all trigger sources come together and, depending on their setting, can generate a recorder trigger. This can be blocked, however, by qualifiers: If one of the qualifiers is not armed, no recorder trigger can be generated.

- **Channel 1 through N:** These are the channel triggers as described earlier. Refer to Figure “Channel triggers combined” on page 241 for a more accurate diagram.
- **External Trigger In:** This is an external trigger signal that is mainframe-related: The input connector is placed on the mainframe controller. You can select to use it or not. When selected, all recorders in the mainframe use it. It is not used on a per-recorder basis.
- **Qualifier 1 through N:** These are the qualifiers as described earlier: See "Trigger qualifier" on page 251.
- **External Trigger Out:** The recorder trigger can be used to send a trigger signal to the outside world. The output connector is placed on the mainframe controller. When selected, all recorders in the mainframe use it. It is not used on a per-recorder basis.

- **Internal Trigger Line 1 through 3:** There are three internal trigger lines. These are used to transfer recorder triggers from one recorder to another. Each recorder can select to set its recorder trigger on one or more lines. It can also pick up a trigger from one or more lines.
- **Master/Slave:** Multiple mainframes can be synchronized by using the Master/Slave module. When in use, a recorder can put the recorder trigger on the Master/Slave trigger line and/or pick up the trigger from the Master/Slave trigger line.

10.6 Channel alarm

Each channel has the capability to generate an alarm. An alarm situation is detected with a basic dual level detector.

There are two alarm modes:

- Basic single-level alarm. For details see "Basic trigger mode" on page 246.
- Dual-level alarm. For details see "Dual trigger mode" on page 247.

The output of the alarm detector is sent to an alarm line and combined (OR-ed) with alarm conditions of the other channels and recorders. The result is available as an external output located on the mainframe controller.

A Specifications

A.1 GEN7t and GEN16t dimensions

There are two different GEN series mainframes available:

- The 7-slot “tower” mainframe GEN7t is best for smaller channel count applications, has a carrying handle and can be easily transported.
- The 16-slot “rack” mainframe GEN16t offers higher channel count and can be mounted in a 19” rack or used as a standalone desktop instrument.

All technical specifications except mechanics, environmental, power consumption and number of module slots are identical for both versions.

GEN7t model physical / environmental		
Component	**Unit Description**	**Value**
Dimensions (Approximately)	Width	247 mm (9.72“)
	Depth	378.3 mm (14.89“)
	Depth With module ejectors	386.2 mm (15.20”)
	Height Including carrying handle in horizontal position	490 mm (19.3“)

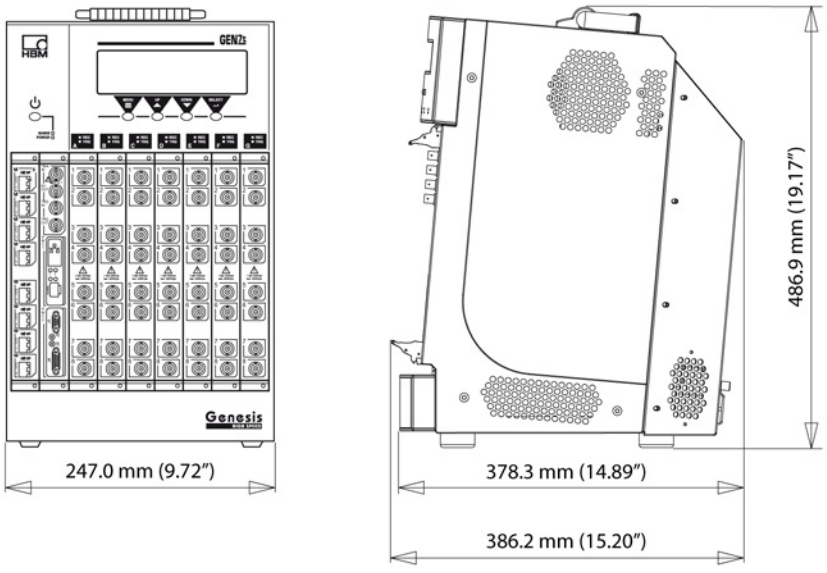


Figure A.1: GEN7t model dimensions

GEN7t model physical / environmental		
Component	**Unit Description**	**Value**
Weight		10 - 18 kg (22 - 40 lb)
Power		85 - 264 Vac, 450 VA maximum
Temperature	Operating	5 to 35 °C (41 to 95 °F)
	Non-operating	-20 °C to +60 °C (-4 °F to +140 °F)
Humidity	Operating (Non-condensing)	0 - 80 %
Capacity	Slots for acquisition modules + 1 slot for master/slave board	7

GEN16t model physical / environmental		
Component	**Unit Description**	**Value**
Dimensions (Approximately)	Width	483 mm (19.0“)
	Depth	501 mm (19.7“)
	Height	412 mm (16.2“)

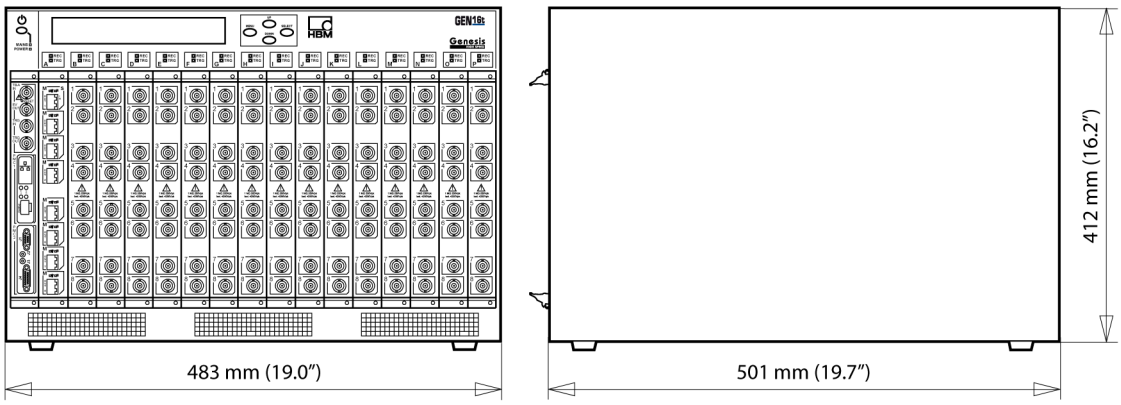


Figure A.2: GEN16t model dimensions

GEN16t model physical / environmental		
Component	**Unit Description**	**Value**
Weight		20 - 36 kg (44 - 79 lb)
Power		100 - 240 Vac, 1200 VA maximum

GEN16t model physical / environmental		
Component	**Unit Description**	**Value**
Temperature	Operating	0 to 40 °C (32 to 104 °F)
	Non-operating	-20 °C to +60 °C (-4 °F to +140 °F)
Humidity	Operating (Non-condensing)	0 - 80 %
Capacity	Slots for acquisition modules or master/slave board	16

Controller options		
Component	**Unit Description**	**Value**
Slots	For one of the available optional boards. Boards are factory installed or upgraded only.	1

Timebase		
Component	**Unit Description**	**Value**
Source	The GEN series mainframes provide a central timebase for all acquisition modules.	
Accuracy	IM1	< 30 ppm
	IM2	15 ppm

Synchronization		
Component	**Unit Description**	**Value**
Trigger	4-wire internal trigger bus allows for AND/OR combinations of trigger sources to trigger any acquisition module.	
	With optional master/slave boards synchronization between multiple mainframes.	
M2	When the IM2 module is used Synchronization is currently possible between GEN2i mainframes only.	

Local control		
Component	**Unit Description**	**Value**
Display	2 lines of 20 characters for status, alarms, network setup.	
Control	System, network setup	

Safety - For all models		
Component	**Unit Description**	**Value**
Measuring Category	IEC 61010	CAT I
Ingress Protection (IP)	IEC 60529	IP20
Pollution Degree	IEC 60664	2

19 inch Rack (rack mounted 16t only)		
Component	**Unit Description**	**Value**
Dimensions (Approximately)	Width	447 mm (17.6")
	Depth	501 mm (19.8")
	Height 9u[1] not inc. feet 10u including feet	412 mm (16.2“)

(1) 1u = 44.5 mm

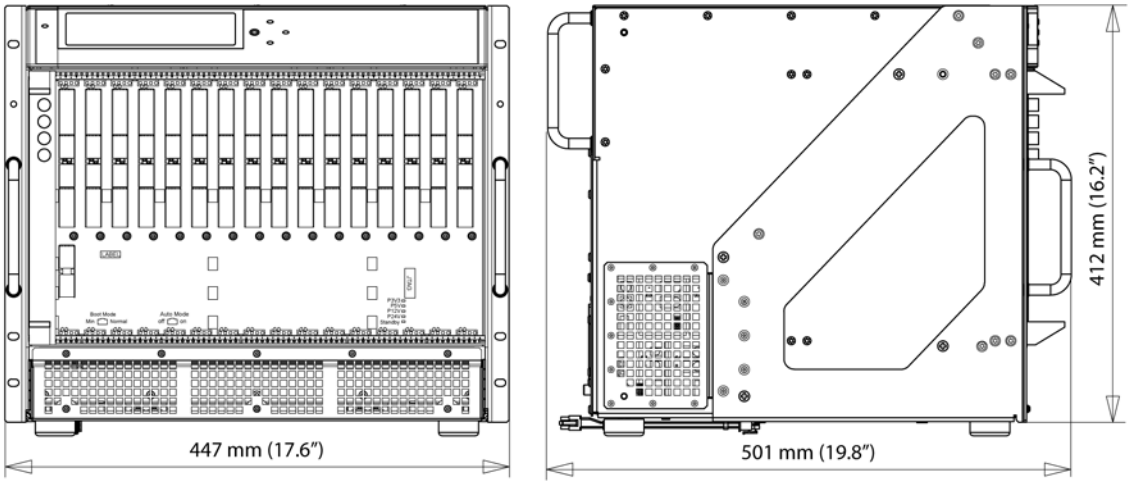


Figure A.3: GEN16t model - 19 inch Rack

Consult www.hbm.com/highspeed for more information.

A.2 SFP Ethernet Option dimensions

SFP Ethernet Option		
Component	**Unit Description**	**Value**
Dimensions (Approximately)	Width (Front)	13.8 mm (0.541”) ± 0.1 mm (0.004”)
	Width (Back)	13.4 mm (0.528”) ± 0.1 mm (0.004”)
	Depth	55.2 mm (2.17”) ± 0.2 mm (0.01”)
	Depth With process plugs	61.8 mm (2.431”)
	Height	8.5 mm (0.335”) ± 0.1 mm (0.004”)

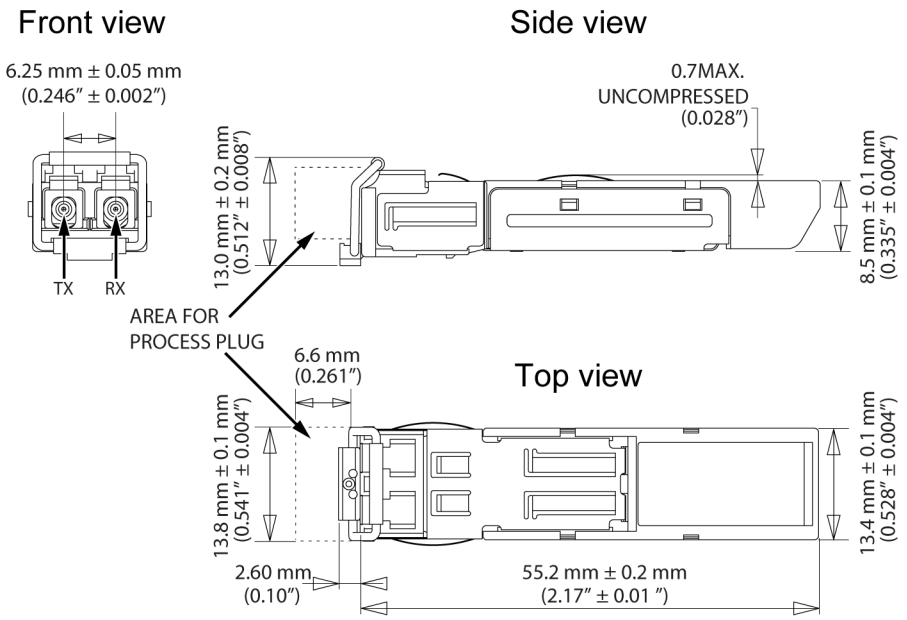


Figure A.4: SFP Ethernet Option dimensions

B Maintenance

B.1 Upgrading firmware

Note *If you are using Perception 6.14 or higher, firmware is automatically upgraded.*

Your instrument stores its operating instructions in internal non-volatile flash memory which you can easily upgrade as HBM adds new features and functions. The process is comparable to upgrading the BIOS in your PC. You may check HBM's web site www.hbm.com/highspeed for the latest versions, or you may subscribe to an automatic maintenance service that will assure you always receive applicable upgrades. Please contact your HBM representative for details on available subscriptions.

Upgrading the GEN series firmware requires an application that either came on a CD supplied with your hardware or you downloaded through the Internet update service. Run Setup to install this software.

To update the firmware proceed as follows:

1. Turn the instrument on and wait for it to display "Ready" or “Fast Streaming” on its local display.
2. Ensure your PC is connected correctly to the instrument by a network cable or via a network switch or hub *(if you have been successfully using the instrument with Perception, your connection is correct).*
3. Make sure no other software is active on your PC and close the Perception application before using the upgrade software.
4. To start the upgrader on your PC click **Start**, point to **All Programs**, point to **HBM**, point to **GEN series**, point to **Firmware Upgrader** and click **GEN series Firmware Upgrader**. This will launch the application.
5. Read pop-up messages carefully before continuing. They may contain important information with respect to the upgrade process.

6 Depending on your security settings the following dialog may come up:

Figure B.1: Windows Security Alert dialog

Select **Unblock** to continue.

7 A dialog appears:

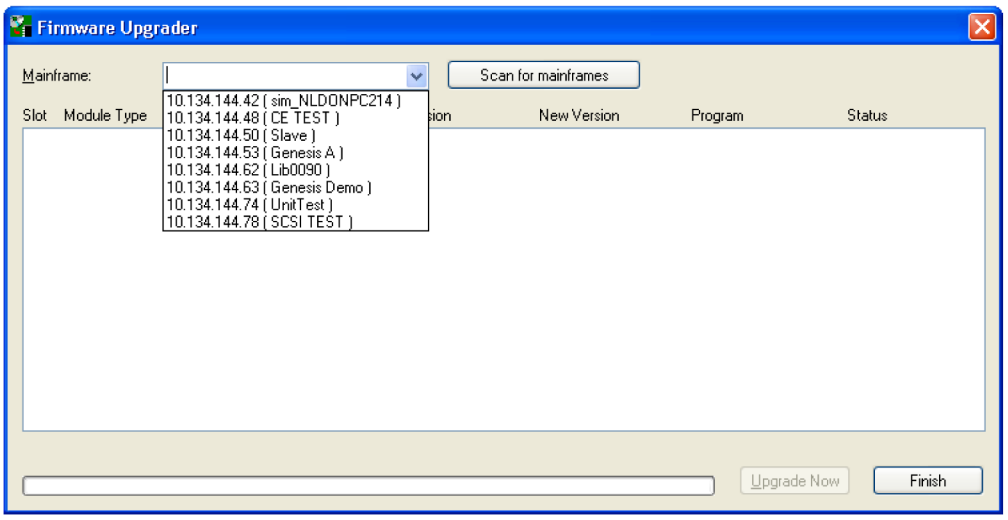


Figure B.2: Firmware Upgrader dialog (1)

Click the down arrow of the Select mainframe list. This will give you a list of available mainframes, identified by both the IP address and network name. You may need to click the Scan network button to update/refresh the list.

8 Select the system you need to upgrade. You will be prompted for a password when the system is password protected. The default password for the GEN series is "genesis", all in lower case and without the quote marks. If you have changed your password, you will be prompted here, otherwise the program will continue automatically.

9 When connected the FirmwareUpgrader utility checks your mainframe's current versions and compares them to the upgrade versions to see if an upgrade is necessary:

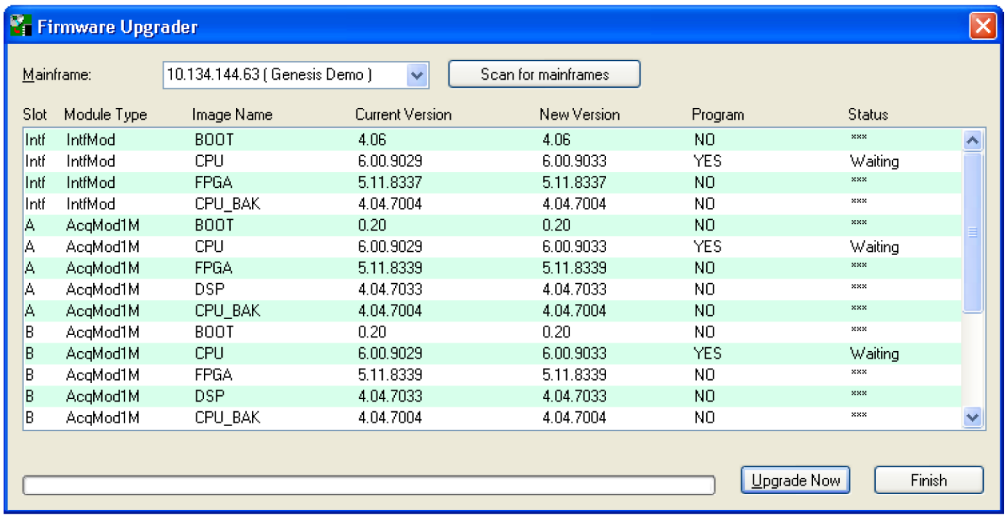


Figure B.3: Firmware Upgrader dialog (2)

The Upgrade column shows which firmware parts will be upgraded. The Status column shows the status of the upgrade process.

10 Click **Upgrade Now** to start the upgrade process. Allow up to 15 minutes for the upgrade to complete. A progress indicator is shown in the bottom status bar.

WARNING

DO NOT for any reason switch off your computer, your instrument, or close the upgrade program while an update is in process. Your instrument could be DAMAGED PERMANENTLY and require factory repair if the upgrade is interrupted.

When finished, the message **Ready** appears at the bottom of the screen. Click the **Close** button to exit.

11 Your instrument must be powered down and restarted for the new firmware to take effect. After rebooting, the startup screen will display your new CPU version and the instrument is ready for use. The upgrade is now completed.

When major new features have been added since the prior version, it is possible an upgrade to the Perception control software may also be necessary. If so, you will be advised the next time you start Perception and attempt to connect. If no message appears your versions are compatible.

B.2 Cleaning

To clean the instrument, disconnect all power sources and wipe the surfaces lightly with a clean, soft cloth dampened with water.

The GEN series does not require additional routine cleaning. If the cooling inlets on the bottom of the sides become clogged with dust, use a small brush and/or vacuum cleaner to remove the dust.

B.3 Formatting a SCSI for use with the GEN series

The volume to be created and formatted has to be a FAT32 file system with a cluster-size of 32768 bytes. All windows versions are capable of detecting and working with FAT32 volumes up to 2 TB. However, every Windows version has the limitation that it can only create and format FAT32 volumes up to only 32 GB. Most SCSI disks are capable of holding much larger volumes and GEN series mainframes support volumes up to 1 TB. A third party windows format tool is required to create the volume using a windows PC that is supported by GEN series mainframes.

To prepare a SCSI disk to be uses on a GEN series mainframe the following steps have to be performed on a windows PC:

1 Connect a Windows 2000 PC or higher to the SCSI disk and reboot the PC.

2 Open the control panel and choose “administrative tools”.

3 Open “Computer Management”.

4 Open “Disk Management”.

5A The SCSI disk should be visible as a disk that only has **Unallocated Space** like in the screen-shot Figure B.4.

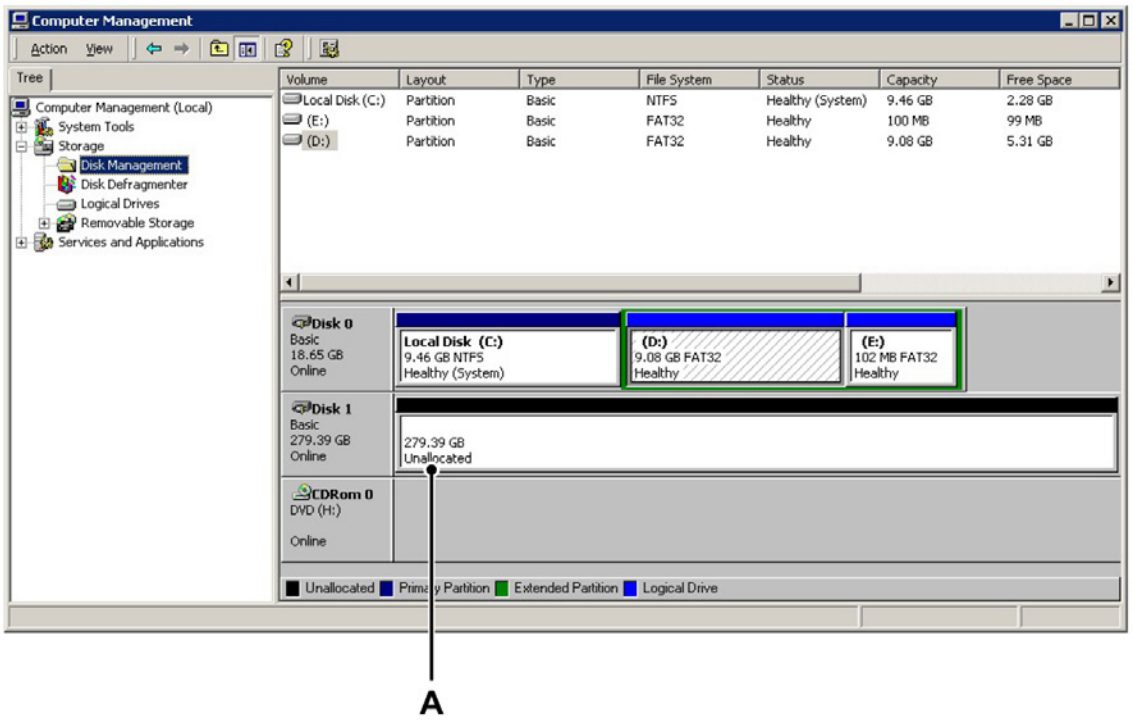


Figure B.4: Computer Management - Unallocated Space

A Unallocated Space

5B In case the disk is detected as “Dynamic”, change it to “Basic” ...
Right click on the grey box where “Disk 1” is written and select the option “Revert to basic disk”.

6 Right click on the long white box containing **GB Unallocated**, select **Create Partition** and click next.

7 Select **Primary Partition** and click **next**.

8 Confirm the partition size with the maximum possible size and click **next**.

9 Choose **Assign a drive letter** and click next.

10 Choose **Do not format this partition** and click next.

11 Click **Finish** and close the **Computer Management** window.

12 Start a command prompt and use the utility “fat32format.exe” from there, using the drive letter assigned to the newly created partition (e.g. “fat32format f:”).

13 Confirm the format with Y and Enter.

After the format has been completed, the SCSI disk should be accessible using the windows explorer. The SCSI disk has to be connected with the GEN series mainframe again. The GEN series mainframe has to be rebooted. The SCSI disk is now ready to be used.

C Service Information

C.1 General - Service Information

HBM offers comprehensive factory servicing for all HBM Data Acquisition products. Extended warranties for calibration, repair or both are available. Installation, on-site or factory training are also available. Contact the factory or your local sales person for more information. For local contact information, visit www.hbm.com/highspeed.

If servicing is ever needed on your GEN series, contact the factory with the model and serial numbers, a description of the problem, and your contact information. You will be issued a Return Material Authorization (RMA) number. Attach this number to the unit and/or the accompanying paperwork.

During the warranty period, the customer pays for shipping to HBM. HBM will pay for the return of the equipment in the same fashion as it was received. Outside the warranty period, a quote will be given. A purchase order must be received before work can be performed.

It is recommended that the unit always be shipped in the original shipping container. For frequent shipping, HBM offers a hard shipping container specifically designed for the transport of the GEN series and its accessories.

C.2 Preventive maintenance

Regularly scheduled HBM preventative maintenance services that include cleaning, adjusting, inspection and calibration will help you to:

- Assure that your instrument is available when you need it
- Maintain optimum performance
- Avoid expensive unplanned downtime and repair

Also, regularly scheduled maintenance is a predictable expenditure.

Frequency of preventive maintenance depends on your application, workload, and regulatory requirements.
The GEN5i system is factory calibrated as delivered to the customer. Swapping, replacing or removing of boards may result in minor deviations to the original calibration.

HBM recommends that the GEN5i system should be tested and if necessary, calibrated, at one year intervals or after any major event that may effect calibration. When in doubt consult your local supplier.

Note *It is recommended to replace system hard disks every 2 years to avoid data loss.*

C.3 Calibration / verification

The GEN series Data Acquisition System is factory calibrated as delivered to the customer. Swapping, replacing or removing of boards may result in minor deviations to the original calibration. The GEN series system should be tested and if necessary, calibrated, at one year intervals or after any major event that may effect calibration. When in doubt consult your local supplier.

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